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Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives

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NUCLEAR WASTE

Defense Waste Processing Facility—Cost, Schedule, and Technical Issues

GAO/RCED-92-183

GAO
United States
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Resources, Community, and
Economic Development Division

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June 17, 1992

The Honorable Mike Synar
Chairman, Environment, Energy, and
Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

As you requested, this report presents the current status of the Defense Waste Processing Facility (DWPF) and its supporting facilities and identifies technical and other issues that may affect the DWPF program. The Department of Energy initiated efforts to end the interim storage of its high-level radioactive waste at the Savannah River Site by developing plans to design and construct the DWPF to treat the waste and transform it into a more stable glass form—a process referred to as vitrification—and then ship it to a geologic repository for permanent disposal. We are recommending that the Secretary of Energy assess and compare the existing technology and an alternative technology that pretreats the waste before it reaches the DWPF.

As arranged with your office, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretary of Energy and the Director, Office of Management and Budget. We will also make copies available to others on request.

This work was performed under the direction of Victor S. Rezendes, Director, Energy Issues, who can be reached on (202) 275-1441 if you or your staff have any questions. Other major contributors to this report are listed in appendix II.

Sincerely yours,

J. Dexter Peach

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Since the early 1980s the Department of Energy (DOE) has been planning for or constructing various facilities to treat and dispose of 34 million gallons of high-level radioactive waste stored in underground tanks at the Savannah River Site in South Carolina. The major facility involved is the Defense Waste Processing Facility (DWPF). As a result of concerns about potential problems with the DWPF and delays in its scheduled start-up, the Chairman of the Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked GAO to review the status of the DWPF and other facilities. This report addresses cost and schedule issues for the DWPF and other facilities, management problems identified and improvements initiated, and technical issues and other uncertainties that could affect costs and the schedule.

Background

DOE began efforts to end the interim storage of Savannah River's high-level radioactive waste by selecting a vitrification process—to be carried out at the DWPF—that treats and transforms the high-level waste into a more stable glass form for permanent storage underground. A number of supporting facilities are also needed to remove, transfer, store, pretreat, and handle the waste before and after the vitrification process. Before it is vitrified, the waste will undergo two key pretreatment processes—one to separate the high-level waste from other material in the storage tanks and a second one to remove explosive organics, primarily benzene, before the waste goes into the DWPF's melter, where the vitrification process (the mixing of the waste with a glass-forming material) takes place. Once the DWPF becomes operational, DOE estimates that it will take more than 15 years before all waste is vitrified. The DWPF and its supporting facilities—referred to in this report as the DWPF program—are run for DOE by the Westinghouse Savannah River Company.

Results in Brief

The DWPF program has experienced cost increases and is now estimated to be a nearly $4 billion effort that will run about 5 years behind schedule. Further delays are possible because of technical issues and other uncertainties. Much of the cost growth and schedule slippages resulted from ineffective DWPF management. For example, the DWPF program has lacked a comprehensive start-up plan and a realistic date for the start of vitrification operations. These management problems were the focus of DOE oversight reviews and assessments in 1991, and DOE has since moved to improve the situation. In addition, because of the way in which funding and budget information about the DWPF program had been reported by DOE in the past, the Congress did not have a clear picture of the cost increases

and schedule slippages. DOE has also initiated actions to correct this situation.

Further cost and schedule changes are also possible given some current or potential technical problems. For instance, the two key DWPF pretreatment processes have had technical problems in the past and are still having problems. If these problems are not resolved, both cost and schedule could be adversely affected. At the same time there are potential advances, such as reduced operating costs, involving an alternative pretreatment method that raise questions about which pretreatment technology can come on-line quickest and offer environmental, safety, performance, and cost advantages. Although DOE plans to start a project to replace the two key pretreatment processes with the alternative technology in the mid-1990s, a more thorough assessment is needed to determine whether this plan should be accelerated.

Principal Findings

Cost Growth and Schedule Slippages Have Continued

In 1987 the DWPF facility was projected to cost an estimated $1.2 billion and to begin vitrifying waste in September 1989. A January 1992 cost estimate prepared by Westinghouse, which had not been completely reviewed or approved within DOE as of mid-May 1992, now projects a $2.1 billion cost for the DWPF, with vitrification operations scheduled for June 1994. Of the DWPF's projected $2.1 billion cost, about $1.4 billion has already been spent. The supporting facilities, without which the DWPF cannot fully and reliably operate, have also experienced delays in projected start-up dates and will cost an estimated additional $1.8 billion, of which about $357 million has already been spent. To date, about $1.8 billion has been spent and an additional $2.2 billion is still estimated to be spent on the DWPF program.

Management Ineffectiveness Was a Major Factor Affecting Cost Growth and Schedule Slippages

DWPF management, according to a December 1991 DOE assessment, did not focus sufficient attention on technical, institutional, or management issues, thereby failing to minimize resource requirements and schedule delays. DOE faulted DWPF managers for their lack of experience with large-scale, first-of-a-kind technology projects like the DWPF. An earlier 1991 DOE assessment also cited the management problems at DWPF as a primary example of ineffective Westinghouse senior management

involvement. According to the assessment, "there is no objective evidence of a thorough definition of start-up requirements, an integrated schedule to meet those requirements, and staffing levels to meet the schedule."

Other factors affecting the DWPF's cost growth and schedule slippages, according to DOE officials, included system testing that identified technical problems and equipment and design deficiencies. Similarly, the increased costs of the supporting facilities reflect the need for upgrades and new equipment to meet newer safety and environmental standards. Some supporting facilities and upgrades also grew out of the need to respond to changes within the vitrification process. For example, because the pretreatment process for separating high-level waste from other material in the storage tanks generates benzene, a highly combustible element, facilities had to be built and upgraded to handle it. Such changing needs have added time to the schedule before radioactive waste processing can begin.

DOE has begun the process of instituting various changes to improve its own management practices and those of its operating contractor. For example, the DWPF organization has been completely restructured to clearly define and fix management authority, responsibility, and accountability for start-up activities. Other key DWPF improvements included the development of a new start-up plan and start-up schedule in February 1992.

More Complete and Accurate Information Is Needed on the DWPF Program

Since 1989 DOE has not presented the Congress with the best information DOE had available about the DWPF program's cost increases and schedule slippages. For example, DOE budget requests were required to report DWPF cost and schedule information only as long as DOE requested funding to complete construction. The last such report was for the fiscal year 1989 budget request, when the DWPF's total construction cost was estimated at $930 million, with an additional $330 million estimated for start-up and other costs funded from operating funds. On the basis of the projected June 1994 start-up date, an estimated additional $879 million will be needed to complete the construction and start-up of a DWPF that can perform radioactive operations. In addition, while some supporting facilities were authorized as separate construction projects, others were built and modified with operating funds.

Although it used various means to report some of the cost and schedule information, DOE's past funding and reporting methods did not provide the

Congress with a clear picture of the full magnitude of the program and the continuing cost growth and schedule slippages. However, as a result of DOE's examination of funding practices at Savannah River, DOE determined that the Congress should be provided more complete and accurate information on the DWPF program. DOE had actions under way as of early May 1992, such as initiating efforts to reestablish the DWPF as a separate construction project in DOE's budget submissions, that would provide the type of cost and schedule information the Congress should have to fully understand the current status of the DWPF program.

Technical Issues Could Further Affect Cost and Schedule

DWPF management—which has had to react to technical problems before, such as the generation of benzene during the pretreatment process—faces new problems. For example, problems with the buildup of highly explosive gasses created during the vitrification process are currently being worked on. Because of the potential for an explosion, these problems must be resolved before vitrification operations can begin.

Another technical issue that could adversely affect both cost and schedule involves DOE's plans to replace the two key pretreatment processes with an alternative method in the mid-1990s. DOE assessments of this alternative method have shown that it may offer potential advantages over the existing processes—such as reducing operating costs and eliminating benzene in the pretreatment process—but further examination of these issues is needed.

Recommendation

GAO recommends that the Secretary of Energy direct that an assessment and comparison of the existing and alternative pretreatment technologies be prepared to determine whether DOE should accelerate its planned efforts to replace the existing technology.

Agency Comments

As requested, GAO did not obtain written agency comments on a draft of this report but did discuss the facts with responsible waste management officials at DOE's Savannah River office. Their comments have been incorporated where appropriate.

Contents

Abbreviations

DOE	Department of Energy
DWPF	Defense Waste Processing Facility
EPA	Environmental Protection Agency
GAO	General Accounting Office
ITP	in-tank precipitation
IXP	ion-exchange process
OMB	Office of Management and Budget
PHP	precipitate hydrolysis process
RCRA	Resources Conservation and Recovery Act
SRS	Savannah River Site
WSRC	Westinghouse Savannah River Company

Introduction

The Department of Energy's (DOE) Savannah River Site (SRS) was established in 1950 by the U.S. Atomic Energy Commission to produce nuclear materials for the nation's defense. The production of these nuclear materials resulted in radioactive waste by-products and hazardous waste that have been stored at SRS for years. In the early 1980s DOE initiated efforts to end the interim storage of its high-level radioactive waste by developing plans to treat the waste and transform it into a more stable glass form—a process referred to as vitrification—and then ship it to a geologic repository for permanent disposal. These efforts culminated in DOE's decision to design and construct the Defense Waste Processing Facility (DWPF),[1] where the vitrification process would take place. In addition to the DWPF's construction, other facilities are required to support the DWPF. These supporting facilities include a mixture of newly constructed or yet-to-be-constructed facilities combined with either upgrades to or modifications of existing facilities. The DWPF program—referred to in this report as the DWPF and its supporting facilities—was begun under one contractor's management and is now run by a new contractor, the Westinghouse Savannah River Company (WSRC).[2]

High-Level Radioactive Waste at SRS and the Vitrification Process

As of February 29, 1992, SRS had stored in waste tanks about 34 million gallons of high-level radioactive mixed waste. This waste consists of about 3.8 million gallons of sludge, 14.7 million gallons of salt, and 15.1 million gallons of liquid called supernate. The waste contains about 538 megacuries[3] of beta-gamma radioactivity, which is the most curies of radioactivity stored at any site in the DOE complex. The waste is stored in 51 underground tanks.[4]

The tanks can contain (1) sludge, salt, and supernate; (2) sludge and supernate; and (3) salt and supernate.

[1]In late 1989 we issued an overall report on DOE's efforts to dispose of high-level waste that presents a broad discussion of the DWPF. See Nuclear Waste: DOE's Program to Prepare High-Level Radioactive Waste for Final Disposal (GAO/RCED-90-46FS, Nov. 9, 1989).

[2]E.I. du Pont de Nemours (Dupont) managed and operated the SRS facilities for DOE from the 1950s until April 1, 1989, when WSRC became the new operating contractor.

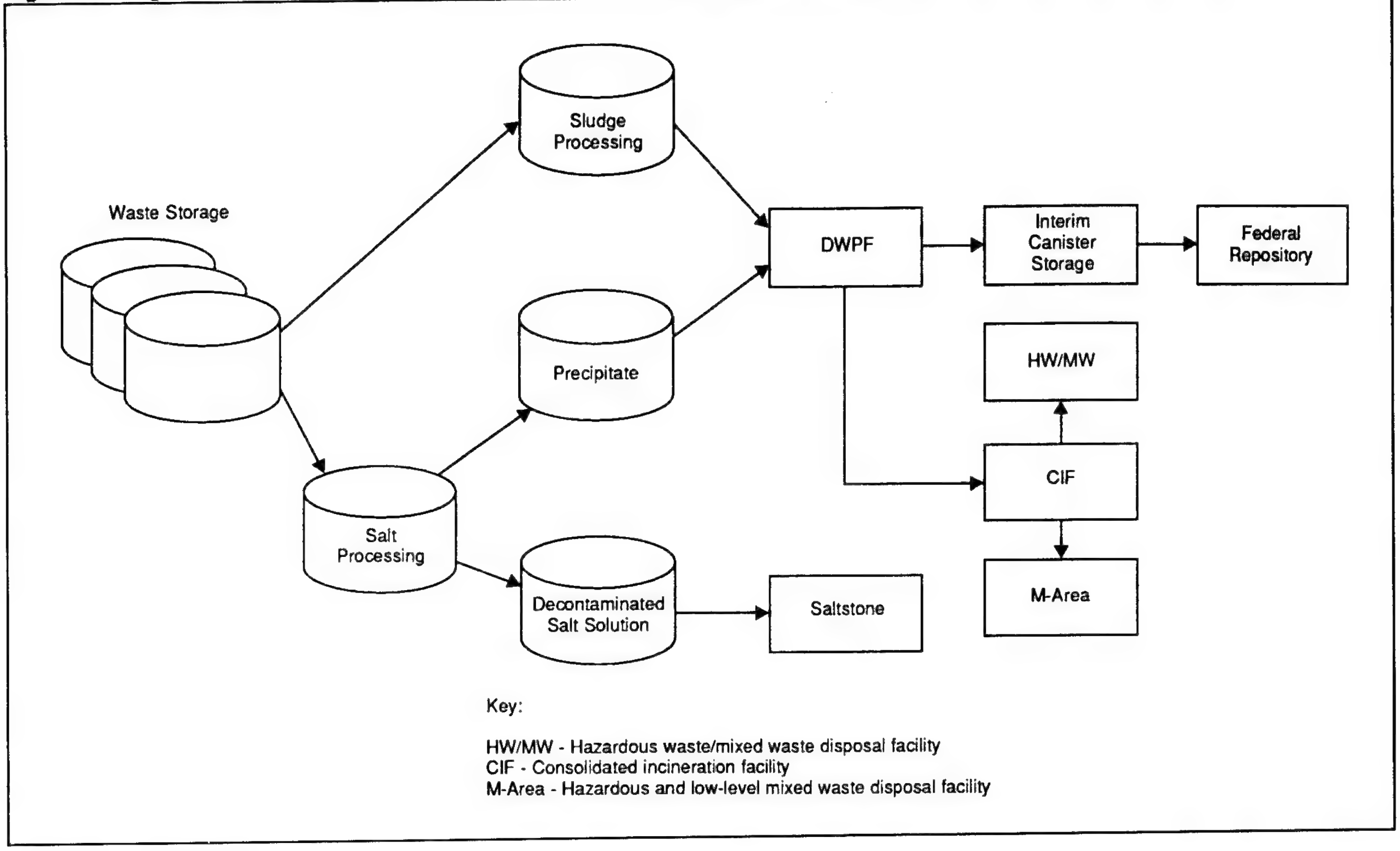
[3]A curie is a basic unit of radioactivity, which is equal to 3.7×10^{10} radioactive disintegrations per second.

[4]According to DOE officials at SRS, eight of the tanks are in contact with the water table and four of them have cracks. Another five tanks not in contact with the water table also have cracks. Waste in the cracked tanks is maintained below the cracks to protect the environment.

- The sludge sits on the bottom of the tanks and consists of iron, manganese, aluminum, and other insoluble components. The principal radioactive elements are strontium and plutonium.
- The saltcake is a solid and consists mainly of sodium salts. The primary radioactive element is cesium.
- The liquid sits on top of the sludge or saltcake, whichever is contained in the tank. The main component in the liquid is sodium salts and the primary radioactive element is cesium.

During the 1970s DOE decided to pursue permanent disposal of the SRS waste rather than maintain it in the storage tanks and continue to add storage capacity. This decision required the immobilization of the liquid waste. To do this, the waste in the underground storage tanks will be separated into three streams: high-level radioactive insoluble sludge, high-level radioactive precipitate, and low-level radioactive water-soluble salts (hereafter referred to as decontaminated salt solution). This waste will then be immobilized in two main facilities: the DWPF and the saltstone facility. Figure 1.1 provides a flow diagram of the process.

Figure 1.1: High-Level Radioactive Waste Treatment and Processing Flow Diagram



The sludge portion of the waste is washed in existing waste tanks to remove aluminum and soluble salts before transfer to the DWPF. The soluble salt portion of the waste contains radioactive elements that must be removed before the decontaminated solution can be processed into saltstone. Radioactive elements are removed from the salt solution in the in-tank precipitation (ITP) process and, after an organic removal step, referred to as precipitate hydrolysis, are blended with the sludge or slurry stream. After a process to remove mercury from the waste, a glass-forming material called frit is added, and the mixture is concentrated by evaporation. The resulting mixture is fed to a melter, where it is heated, and the molten glass is poured into stainless steel canisters. The outsides of the canisters are decontaminated and the top is welded closed. The canisters—which are about 2 feet in diameter and 10 feet tall and can contain up to 230,000 curies of radioactivity—are then stored at SRS in an

interim storage building until they can be shipped for permanent disposal at a federal repository. Each canister will contain about 165 gallons of vitrified waste and, once the DWPF is in operation, about 410 canisters will be filled each year. Once the DWPF becomes operational, DOE estimates that it will take more than 15 years before all of the waste is vitrified.

At the saltstone facility the decontaminated salt solution is immobilized by mixing it with cement and flyash. The grout formed in this process is pumped into above-ground storage vaults where it hardens into concrete monoliths called saltstone. Each cell of a vault is covered with a temporary portable roof to prevent rainwater from diluting and altering the composition of the saltstone during the filling operation and until the saltstone cures. Once the cell is filled, a 1-foot layer of uncontaminated concrete is added to cover the saltstone and provide further radiation protection. Each monolith will consist of 1.35 million cubic feet of saltstone containing 6 million gallons of salt solution. Each vault is 600 feet long, 100 feet wide, and 25 feet tall. Three of these vaults have been constructed, and DOE currently plans to construct 12 additional double-wide vaults to dispose of the saltstone.

The DWPF program has evolved over time and resulted in many changes due to a number of factors, such as design changes, technology changes, and regulatory requirements. In addition, the DWPF, by itself, cannot be viewed as a single project to vitrify high-level radioactive waste. A number of facilities are required to remove, transfer, store, and pretreat the waste stream before it goes to the DWPF and to store, dispose of, and ship the waste leaving the DWPF. In appendix I we provide further detailed information on the evolution of the DWPF program and a description of the facilities required to support the DWPF.

Objectives, Scope, and Methodology

The Chairman of the Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked us in a letter dated October 15, 1990, to determine the current status of the DWPF and its supporting facilities and to identify any technology limitations or other issues that may affect cost, schedule, or performance. On the basis of subsequent briefings and meetings with the requester's staff, we agreed to examine (1) cost and schedule issues for the DWPF and its supporting facilities, (2) management problems identified and improvements initiated, and (3) technical issues and other uncertainties that could affect both costs and schedule.

To develop the cost and schedule information on the DWPF and its supporting facilities, we reviewed WSRC's project plans and budget documents; DOE's management and funding of the project; DOE's budget documents; other operating contractor documents describing the evolution of the project; reports on budget, technical, and other issues prepared by WSRC and DOE; reports on project progress and problems prepared by DOE and WSRC; reports prepared by DOE consultants and contractors providing support services to DOE personnel at SRS; and other files and documents related to the DWPF and other supporting facilities. In addition, we interviewed DOE and WSRC officials in Germantown, Maryland, and at SRS to obtain cost and schedule data.

To determine the management problems experienced at the DWPF and its supporting facilities and any improvements that had been initiated, we examined various reports, reviews, and assessments prepared by the DOE Office of Inspector General, SRS offices, the SRS operating contractors, and DOE headquarters offices. These assessments included the DOE Office of Inspector General's report on SRS' construction carrying account, monthly and quarterly project status reports, DOE's semiannual evaluations of WSRC performance at SRS, and SRS-wide reviews initiated in 1991 that focused on both project and financial management problems. In addition, we interviewed DOE and WSRC officials in Germantown and at SRS to discuss management problems and management initiatives related to the DWPF and its supporting facilities.

To examine whether technical issues and other uncertainties could affect both costs and schedule, we reviewed technical reports, reviews, and assessments prepared by DOE and/or the SRS operating contractor and held discussions with DOE and WSRC officials responsible for the DWPF and its supporting facilities in Germantown and at SRS.

We toured the DWPF and a number of its supporting facilities, such as the Saltstone facility. In addition, we also visited two European facilities that have vitrified high-level radioactive waste. One facility was near Brussels, Belgium, and was operated by Belgoprocess. The other facility was in Sellafield, England, and was operated by British Nuclear Fuels Limited. The purpose of these visits was to get a better understanding of the actual operations involved in vitrifying waste.

We did not obtain written agency comments on a draft of this report. We did, however, discuss the facts with responsible DOE staff from DOE's Office of Environmental Restoration and Waste Management at SRS, and we

incorporated their views where appropriate. We conducted our work from March 1991 through May 1992 according to generally accepted government auditing standards.

Cost Growth and Schedule Slippage Have Continued for the DWPF and Its Supporting Facilities

The DWPF and its supporting facilities have experienced increased cost growth and schedule slippage. WSRC estimates that construction of the DWPF and its supporting facilities will cost nearly $4 billion. Actual radioactive operations—vitrifying the waste—are about 5 years behind schedule, and the earliest start date is now projected for June 1994.

DWPF Is Expected to Cost $2.1 Billion, and Start-Up Is Scheduled for the Mid-1990s

The fiscal year 1987 cost estimate for the DWPF was $1.2 billion. WSRC's current cost estimate is about $2.1 billion, of which about $1.4 billion had been spent as of December 31, 1991. As a result, an estimated additional $746 million remains to be spent on the DWPF. And actual radioactive operations, once scheduled for September 1989, are now projected to start in June 1994. WSRC's latest cost and schedule information, which was presented to DOE headquarters in January 1992, had not been fully reviewed or approved by DOE as of May 12, 1992. WSRC has already acknowledged that the June 1994 projected date may slip even further to July 1995, although DOE officials believe that the June 1994 date is more realistic.

In Early 1990s Costs Increased Sharply, and Scheduled Start-Up Slipped Dramatically

Since fiscal year 1983 the DWPF has experienced wide fluctuations in the costs estimated to complete it and the date for planned radioactive operations. (See table 2.1.) Total estimated cost is defined as all design and construction costs, including any corrective actions due to design or construction errors up to the point of radioactive operations. Total project cost is defined as the sum of the total estimated cost and all other project costs, such as start-up costs, including testing, training, and operational readiness reviews, necessary to achieve radioactive operations.

Table 2.1: DWPF's Changing Cost Estimates and Schedules

Dollars in billions

Fiscal year	Construction costs	Start-up and other costs	Total project costs	Planned radioactive operations
1983	$ .97	$.56	$1.53	2nd quarter FY 1990
1984	.91	.44	1.35	3rd quarter FY 1989
1985	.87	.37	1.24	3rd quarter FY 1989
1986	.87	.35	1.22	3rd quarter FY 1989
1987	.87	.33	1.20	4th quarter FY 1989
1988	.95	.33	1.28	3rd quarter FY 1990
1989	.93	.33	1.26	4th quarter FY 1990
1990	.93	.33	1.26	3rd quarter FY 1992
1991	1.05	.82	1.87	11/92 (+ or - 3 months)
1992	1.22[a]	.92[a]	2.14[a]	6/94[a]

[a]WSRC, in January 1992, presented this information to DOE headquarters environmental restoration and waste management officials. WSRC also predicted at this presentation only a 60-percent probability of achieving this date. The more probable start-up date, according to WSRC, is July 1995. This cost and schedule information had not been fully reviewed or approved by DOE as of May 12, 1992. These costs include $13.8 million (about $10.1 million is for construction) for DWPF fire protection improvements that are part of an SRS-wide fire protection line item.

Source: DOE construction project data sheets, project manager's progress reports, Energy Systems Acquisition Advisory Board data, and other project status reports/estimates for the DWPF.

DWPF Supporting Facilities Are Expected to Cost About $1.8 Billion

The $2.1 billion in estimated costs for the DWPF does not include the construction and start-up costs of all the facilities required for vitrifying the high-level radioactive waste. Excluded are facilities for removing, pretreating, transferring, disposing of, and storing waste. The cost of these facilities are currently estimated at about $1.8 billion,[1] of which about $357 million had been spent as of December 31, 1991. As a result, an estimated additional $1.4 billion remains to be spent on these supporting facilities.

The supporting facilities have been funded from DOE's operating funds for SRS as cost projects (principally facilities for removing and pretreating waste) at an estimated $651 million, and line-item construction projects specifically identified as separate projects in DOE's budgets (facilities for disposing, storing, and transferring the waste) at an estimated $629 million. An estimated additional $535 million is proposed for line-item funding for new facilities and upgrades to existing facilities to support the continued operation of the DWPF in fiscal years 1993 through 1996. Except for the ITP, which is currently scheduled for start-up in December 1992, the supporting facilities are scheduled for completion in the mid- to late-1990s.

Waste Removal and Pretreatment Facilities Total About $651 Million

Waste removal and pretreatment facilities being constructed using DOE's SRS operating funds have exceeded their cost and schedule projections. The construction of the saltstone vaults, using operating funds, is also included among the waste removal and pretreatment facilities. As of December 31, 1991, construction of these facilities (excluding the saltstone vaults), which started in some instances in the early 1980s, was scheduled to be completed in 1997 at an estimated cost of $651 million, of which about $230 million had been spent. As a result, an estimated additional $421 million remains to be spent on these facilities. (See table 2.2.)

[1]According to DOE officials at SRS, some supporting facilities, such as the consolidated incineration facility and certain waste disposal facilities, support both the DWPF and other waste management activities at SRS. However, the supporting facilities are needed for the DWPF to (1) start up, (2) prevent interruptions in its operation after start up, (3) prevent reductions in its production attainment rates, and/or (4) upgrade safety/environmental measures. As a result, the supporting facilities' cost information in this chapter presents the total estimated costs for such facilities and does not allocate a portion of costs solely to DWPF activities.

Table 2.2: DWPF Supporting Facilities—Cost Estimates and Schedules for Waste Removal and Pretreatment Facilities

Dollars in millions

Project	Current costs	Current completion date
Sludge removal[a]	$180	9/97
Salt removal[a]	130	12/95
In-tank precipitation	92	12/92
Saltstone vaults	249	[b]
Total	**$651**	

[a]These waste removal projects were funded in phases and have experienced both cost increases and schedule slippage.

[b]The completion date for the saltstone vaults will vary over time. In total, about 12 double-wide vaults, with an estimated cost of about $233.5 million, and 3 single vaults that have already been constructed at a cost of about $15.9 million will be needed for the disposal of saltstone. The vaults are being constructed as double-wide to make them more effective, efficient, and economical.

Source: Project manager's progress reports and DOE estimates for saltstone vaults.

Waste Disposal, Storage, and Transfer Facilities Total About $629 Million

The current estimated cost of facilities for disposing, storing, transferring, and shipping waste is about $629 million—$442 million for designing and constructing the projects and about $187 million for all other costs necessary to achieve start-up—of which about $127 million had been spent as of December 31, 1991. As a result, an estimated additional sum of nearly $503 million remains to be spent on these facilities. The estimated cost to construct and design the facilities has increased about 62 percent, and the estimated total cost has increased about 119 percent. (See table 2.3.)

Table 2.3: DWPF Supporting Facilities—Cost Estimates and Schedules for Waste Disposal, Storage, and Transfer Facilities

Dollars in millions

	Construction costs		Total project costs		Construction completion date	
Project/facility	**Original**	**Current**	**Original**	**Current**	**Original**	**Current**
New waste transfer facility	$ 45.0	$ 53.6	$ 45.9	$ 84.4	1st quarter 1989	2nd quarter 1994
Hazardous low-level waste processing tanks	49.5	57.8	51.5	77.4	3rd quarter 1995	4th quarter 1997
Consolidated incineration facility[a]	56.0	99.0	63.7	159.9	3rd quarter 1992	1st quarter 1995
Hazardous waste/ mixed waste facility[a]	19.5	59.8	20.5	76.0	2nd quarter 1993	4th quarter 1996
Y-area disposal facility[a,b]	21.5	36.5	23.7	53.1	1st quarter 1993	4th quarter 1996
High-level waste evaporator	44.0	93.3	44.0	129.7	2nd quarter 1993	4th quarter 1994
Diversion box/pit containment building	17.3	24.1	17.7	27.7	2nd quarter 1990	4th quarter 1994
Inter-area line	20.5	18.3	20.9	21.0	3rd quarter 1995	4th quarter 1995
Total	**$273.3**	**$442.4**	**$287.9**	**$629.2**		

[a]According to DOE officials, these facilities would be required with or without the DWPF.

[b]DOE officials informed us in April 1992 that DOE is recommending that this project be canceled.

Source: Construction project data sheets.

Additional New Facilities and Upgrades Total About $535 Million

Additional new facilities and upgrades to existing facilities, required in part for the continued operation of the DWPF, are proposed for funding in fiscal years 1993 through 1996. Although total estimated project cost information has not been developed for all these facilities, the available cost estimate for these facilities is about $535 million. (See table 2.4.)

Table 2.4: DWPF Supporting Facilities—Cost Estimates and Schedules for Additional New Facilities and Upgrades

Dollars in millions

Project/facility	Current construction costs	Current total project costs	Planned funding in fiscal year
Waste removal (FY 1993)	$ 95.7	$116.2	1993
Hazardous waste/mixed waste[a]	22.0	23.5	1994
Sludge receipt and adjustment tank[b]	7.1[c]	7.1[c]	1995
Glass-waste storage building	70.0	72.2	1994
Failed-equipment storage vaults	6.2	6.8	1994
DWPF laboratory	25.0[c]	25.0[c]	1995
DWPF benzene[b]	22.1[c]	22.1[c]	1995
ITP benzene	14.0[c]	14.0[c]	1995
ITP to ion-exchange process	70.0[c]	70.0[c]	1995
Waste removal (FY 1996)	85.0[c]	85.0[c]	1996
Tank-farm service upgrades	45.0	46.8	1994
Low/high-level interim waste storage facility	6.6	6.6	1995
Improved transfer lines	40.0[c]	40.0[c]	1995
Total	**$ 508.7**	**$535.3**	

[a]According to DOE officials, this facility would be required with or without the DWPF.

[b]These projects are physically located within the DWPF building.

[c]Construction cost was the only estimate available.

Source: Construction project data sheets, activity data sheets, and SRS Five-Year Plan (FY 1993 Budget Year).

Also, at least one future construction project—and possibly others—will be required to support the DWPF. The SRS Five-Year Plan for the fiscal year 1993 budget does not include a project for constructing a facility for shipping DWPF canisters to the repository for final disposal. The canister shipping facility, which was not needed in the near term, was deleted from the DWPF construction cost in 1989, but it will have to be constructed in the future. The allowance for deletion of the shipping facility was $14 million. Adding the $14 million allowance to the $535 million increases the estimated cost of future projects to $549 million.

Conclusions

The DWPF program—the DWPF and its supporting facilities—has experienced increased cost growth and one schedule delay after another. Current WSRC estimates indicate that (1) nearly $4 billion will be spent on the program's construction and start-up activities and (2) vitrification operations, once projected to begin in September 1989, will have slipped about 5 years to June 1994. As of December 31, 1991, about $1.8 billion had been spent on the DWPF program, with an estimated additional sum of nearly $2.2 billion expected to be spent in future years.

Ineffective Management Practices Led to the DWPF Program's Cost Growth and Schedule Slippage

Ineffective management by both DOE and its operating contractors has been a principal factor contributing to the cost and schedule problems affecting both the DWPF and the supporting facilities. The result has been extensive cost growth of almost $1 billion and schedule slippages of nearly 5 years for the DWPF alone. It was not until a series of events occurred in 1991, however, that the full extent of the DWPF program's cost and schedule problems really began to receive increased management attention.

At that time the disclosure of DOE funding problems at SRS and cost increases and schedule slippage involving the DWPF and other major projects resulted in DOE's initiating assessments that disclosed weaknesses in DOE's management at SRS. Some assessments related to site-wide activities at SRS, while others were specifically aimed at the DWPF and its supporting facilities. In addition to the management problems, other factors, according to DOE officials, also affected the DWPF's cost growth and schedule slippage. These factors included emerging work, system testing that identified technical problems, and equipment and design deficiencies.

DOE officials believe that they have identified the problems that caused the management weaknesses in the past. As a result, they are now in the process of instituting changes, such as restructuring the DWPF organization to clearly define and fix management authority, responsibility, and accountability for start-up activities, to correct the problems.

Site-Wide Management Problems Identified at SRS

Overall project management problems and project funding irregularities surfaced at SRS in 1991. The initial problem with funding irregularities was identified in a DOE Office of Inspector General report issued in March 1991.[1] This report concluded that the Construction Carrying Account was not always used for the purposes intended and many costs were inappropriately charged to the account.[2] For example, the report provided that the account had been inappropriately used for (1) accumulating and allocating costs, (2) funding capital facilities, and (3) funding and purchasing capital equipment. These practices resulted in significant amounts being carried as an undistributed balance in the account; enabled DOE at SRS to avoid reporting potential funding violations; and caused

[1]Construction Carrying Account at the Savannah River Site, ER-B-91-14, March 14, 1991, DOE Office of Inspector General, Eastern Regional Audit Office.

[2]At SRS all costs of operating the construction activity are derived from other approved funding sources, such as line-item capital projects, general plant projects, and operations. Most costs related to the construction activity are initially collected and recorded in the Construction Carrying Account and subsequently allocated to properly approved and authorized funding sources.

distortions in the cost of line-item projects, operations, and related property and financial statements.

Resulting from the Office of Inspector General report, a DOE headquarters review of SRS construction costs in May 1991, and subsequent DOE headquarters reviews of other SRS facilities, DOE's Acting Manager at SRS established two teams in May 1991—a business management review team and a project review team—to review financial management issues at SRS. Among the major financial and project management findings were (1) inadequacies in management system infrastructure at both DOE and the contractor; (2) selective compliance with DOE orders; (3) lack of clearly defined implementing procedures; and (4) inadequacies in the control system to ensure compliance. The deficiencies found by these review teams related to a number of areas, including a lack of consistent and clear policy direction, weak procedural controls, a lack of aggressive oversight of the contractor's project control and reporting practices, and insufficient staff dedicated to project and financial management and oversight.

Also, due to the project work load and insufficient staffing, project management by DOE's Project Management Division has been limited to the construction phase of line-item projects. In mid-1991 the average work load for each DOE project manager consisted of either one major system acquisition or two major projects and from two to six other line-item projects. This work load forced project managers to devote their time to high-priority projects and the issues involving them.

According to a DOE Project Support Division's 1991 staffing analysis, DOE did not effectively manage the remaining work load of cost projects, general plant projects, and capital equipment. Furthermore, stringent controls and procedures for managing these projects were not even in place. Also, DOE recognized in 1991 that without increased staffing many management problems would continue, including (1) continued operation without needed formal procedures, guidelines, and other important project documentation; (2) lack of surveillance of active construction; and (3) inability to bring about general performance improvements and other management changes advocated as part of overall SRS cultural changes.

According to DOE's Director of the Project Support Division at SRS, needed staffing is still not available to manage cost projects, general plant projects, and capital equipment. He stated that the fiscal year 1992 staffing plan called for 64 full-time-equivalent employees and that staffing had been increased only from 41 to 49 persons. Although eight additional staff

members have been authorized to bring the total to 57, the total still will not allow needed management of all projects, according to the Director.

In addition, DOE headquarters performed a Contractor Business System Review in March 1991. This review found that

- program authorizations were not adequately documented, including planning guidance and scope, cost, and milestone baselines;
- the project management system was not adequate;
- cost efficiency was not a management priority; and
- site staffing was not managed or readily defensible.

Two major concerns identified during this review were that (1) WSRC did not have a cost collection system in place that DOE needs for financial tracking and decision-making and (2) WSRC must improve the organizational aspects of its operations. In general, there were divisions, throughout SRS, acting independently. This resulted in inefficiencies and the lack of proper oversight and control.

DWPF Management Problems Scrutinized

At the same time that overall DOE funding and management problems were being identified at SRS, the DWPF received increased scrutiny in 1991 that pinpointed various management weaknesses. Some of these weaknesses stem from the DWPF's lack of adequate management tools, while others result from how the DWPF was being managed in 1991.

Start-Up and Other Problems

When the DWPF entered the start-up phase in 1989, an adequate start-up strategy had not been defined. As a result, the extent of funding required for start-up was not well understood. The DWPF has continually lacked a comprehensive start-up plan, an accurate cost estimate, and a realistic schedule for radioactive operations. In addition, DOE officials at SRS cited DOE's commitment to adhere to commercial nuclear standards as also affecting the DWPF's cost and schedule.

Funding for construction of the DWPF was made available in July 1983 and construction began in October 1983. At that time, E.I. du Pont de Nemours and Company (DuPont) was the operating contractor at SRS. DuPont was involved in every phase of the DWPF, from research and development to design and construction activities. According to a DOE publication, research conducted by DuPont had reduced the estimated cost of the DWPF from $2.8 billion to $870 million. This publication also projected that

construction would be completed in June 1989 and that the DWPF would begin operations in September 1989. The DWPF did not meet the 1989 schedule or cost estimate, and it may be well into the mid-1990s before DWPF radioactive operations begin.

By mid-1991 WSRC still did not have an adequate schedule. In August 1991 a DOE assessment prepared with assistance from a contractor, found that the then-existing schedule submitted by WSRC, after repeatedly missing target dates,

- did not include a scope of work for items needed to meet schedule milestones;
- did not provide for modifications to equipment;
- illogically presented the sequence of events for start-up, such as scheduling construction before design;
- did not identify problem areas and resource requirements; and
- did not have resources allocated for performance of about 25 percent of the activities in the schedule.

The August 1991 assessment also found that WSRC management had not been driven by a need to meet schedules. Planning meetings did not state what was to be done by whom and by when. Instead, according to the assessment, the planning meetings were simply status report meetings where accountability for schedule commitment was not evident and schedule slippage was accepted without question. Furthermore, no formal program provided written direction for schedule change control, schedule update process, or requirements for formal schedule analysis; and the schedule was not being used to manage day-to-day activities.

In response to the August 1991 evaluation, WSRC completed its preliminary revision of the DWPF's cost estimate and schedule in December 1991 and presented the results to DOE headquarters officials in January 1992. As of mid-May 1992, DOE was still evaluating WSRC's revised schedule and cost estimates.

The lack of good planning also surfaces as the reason for the cost growth. When DOE compiled the $1.26 billion project cost estimate for fiscal year 1989, it did not provide funds for a start-up meeting commercial standards. According to DOE officials, the assumption was that the DWPF could become operational essentially as soon as construction was complete and problems could be fixed after start-up. However, in our opinion, the complex nature of DWPF and the fact that it was a first-of-a-kind technology

that deals with radioactive waste, coupled with DOE's commitment to adhere to commercial standards, should have dictated an extensive start-up phase.

The extent of the deficiencies in DOE's and WSRC's start-up plans are highlighted in the escalation of the DWPF's estimated costs. For example, as of January 1992 the $918 million in estimated start-up and other costs was nearly three times the fiscal year 1990 cost estimate of $330 million.

1991 Assessments Identify Management Problems

In 1991 the DWPF was highlighted in three separate assessments that identified significant management weaknesses. For example, in a memorandum dated March 15, 1991, addressing a February 1991 assessment, the Director of DOE's Office of Environmental Restoration and Waste Management was highly critical of the manner in which the DWPF had been managed. According to this assessment, the

> . . . method of schedule resource loading for the DWPF project is inadequate to permit an independent validation of the accuracy of requested staffing and funding levels. Moreover, this inadequacy is the likely "root cause" of overall project management system deficiencies for the DWPF project, including change control, cost tracking and cost management, resource planning, and baseline development and maintenance. In short, the DWPF project management system fails to provide assurance that the planned activities and resources will lead to start-up and operation of the DWPF on time and within cost projections.

The DOE Site Acting Manager for SRS, in transmitting DOE's evaluation of WSRC performance for the 6-month period ending March 31, 1991, referred to the DWPF as an area of concern. According to the assessment, the DWPF

> . . . is a primary example of ineffective WSRC senior management involvement. While WSRC has been responsive to concerns about schedule delays, funding problems, and manpower levels, there is no objective evidence of a thorough definition of start-up requirements, an integrated schedule to meet those requirements, and staffing levels to meet the schedule. Start-up of DWPF on schedule is not only a Compliance Agreement milestone, but one of the highest priorities in the Waste Operations Program. Involvement of senior management in the start-up of DWPF is of critical importance.

The problems continued to be recognized during the next assessment period. According to this assessment, which was dated December 9, 1991, and covered WSRC's performance for the 6-month period ending September 30, 1991, work plans and schedules for starting up the DWPF continued to

be a concern throughout most of the evaluation period. The assessment cited WSRC's performance in the start-up activities for the in-tank precipitation (ITP) process as falling "far below expectations as evidenced by a lack of commitment to the continually revised schedules." The assessment also concluded that:

> Throughout the majority of the period, WSRC did not focus sufficient management attention on technical, institutional and management issues involving the DWPF. Insufficient management attention was given to the facility start-up and consequently, WSRC did not take the actions necessary to minimize schedule delays and resource requirements. WSRC missed four consecutive commitments in developing a revised start-up schedule for DWPF, and ultimately did not provide a revised schedule until August. Throughout this period, little emphasis was placed on DWPF schedule performance and therefore the schedule continued to slip on a weekly basis.

The assessment ended on a positive note, however, by stating that during the last month of the period, "significant strides were made in improving the management of the DWPF program." It added that a critical self-assessment of the DWPF was conducted and resulted in

> . . . work planning and overall management changes that have already resulted in significant improvements. This assessment, involving experienced nuclear managers from outside WSRC, set forth the critical deficiencies and made recommendations for corrective actions. WSRC is aggressively pursuing these corrective actions which include major organizational changes and increased management focus on DWPF.

Management of Some DWPF Supporting Facilities Has Also Been a Problem

In addition to the DWPF's management problems, some supporting facilities, such as the ITP, have experienced similar problems. For example, contractor management deficiencies contributed to the ITP's cost increases and schedule slippages. These management deficiencies have been evidenced since 1990 by the continuing slippages in the scheduled start-up of the ITP from April 1991 to December 1992.

A November 1991 report on an internal WSRC assessment of the ITP start-up stated that improvements were needed in documentation and overall management of the ITP start-up effort. Specific findings included:

- The ITP start-up program is currently in a reactive mode, and its organization is best described as a reactive organization.

- The current schedule does not contain all remaining activities and is not integrated, and the planning and scheduling staff is inadequate to perform planning and schedule analysis.
- There are unresolved quality assurance issues concerning electrical terminations, among other items, with a potential for more issues to develop from an in-depth review of the older, completed portions of the ITP because documentation is insufficient.
- The ITP has a singular focus on completing start-up testing that is so strong that operational and training issues are receiving less than needed attention.

Also, an earlier, more limited DOE review indicated that WSRC management deficiencies disclosed in the ITP assessment were common to the waste removal cost projects. The review was performed to determine (1) the extent of deviations, if any, from proper cost accounting practices and (2) whether the funding sources were appropriate. It found that recordkeeping and documentation available for the cost-funded projects were less detailed than those found on line-item projects and that formal change control of cost projects' total estimated costs was lacking.

Additionally, DOE did not adequately manage the waste removal and pretreatment cost-funded projects in the past. For example, a DOE headquarters March 1991 Business Management System Review for SRS reported that these projects were not managed under the Department's "Project Management System" and that there was no defined management process for them. Procedures for managing cost-funded projects, either formal or informal, did not appear to exist at the SRS, organizational, or individual project manager levels. Furthermore, definition of such projects was not formalized to ensure assignment to cost funding for appropriate reasons.

Other Factors Affecting Cost Growth and Schedule Slippage

Additional factors affecting the DWPF's cost growth and schedule slippage, according to DOE officials, included emerging work, testing systems that identified technical problems, and many equipment and design deficiencies. For example, in the testing area as of January 1992, the DWPF still required the completion of the integrated water runs, cold chemical runs, waste compliance testing, and mercury recovery—which are scheduled to take until June 1994 to complete—to be followed by initial radioactive operations.

Scheduled completion of these tests and other start-up requirements pushed the DWPF's estimated total project costs to $2.1 billion. No one knows if scheduled testing will clear DWPF for actual operations or whether additional testing, with associated increases in cost, will be required. DOE officials at SRS believe that the need for additional testing presents a low probability, in their opinion. However, an evaluation of a worst-case scenario, according to WSRC, indicates that radioactive operations could be as late as July 1995.

As late as fiscal year 1987, the DWPF was estimated to cost about $1.2 billion and radioactive operations were scheduled for September 1989. The reduction in the DWPF's total estimated project costs between fiscal years 1983 and 1987 resulted primarily from design changes, a lower than expected inflation rate, and a lower contingency amount for the DWPF. As illustrated in chapter 2, between fiscal years 1985 and 1990, the DWPF's total estimated project costs remained relatively constant, but the planned operations date began to slip. Although DOE recognized that estimated costs were increasing before fiscal year 1991, not until December 1990 did DOE officially revise its cost estimate to reflect about a $613 million increase in estimated costs principally related to start-up activities. DOE attributed this large increase in estimated costs, which increased again in fiscal year 1992, to (1) the omission of some system testing and start-up operations costs in the original total project cost estimate and (2) increased annual operating costs over the period of delay and costs associated with fixing problems left over from original construction. These latter costs were identified during start-up testing and system completion activities.

DOE had experienced escalating cost problems involving the DWPF before 1991. For example, the DOE Manager at SRS, in a November 26, 1986, letter to DOE headquarters, discussed the need to revise the fiscal year 1988 DWPF budget request from $870 million to $945 million. According to the letter,

> The major contributors to cost growth on the DWPF were inadequate estimates, inadequate planning, inadequate procurement specifications, and inadequate change control. This was in part due to the fact that the DWPF is a "fast track" project: Construction began without a complete design package in order to compress the project schedule due to tank farm capacity restrictions. There is a risk associated with this method, especially with such a unique and complex facility as the DWPF.

The ITP and the waste removal projects have also experienced cost increases and schedule slippages due to a number of factors, including

scope changes, modifications, budgeting constraints, and compliance with more stringent standards. For example, the ITP project, which is currently scheduled to be completed in December 1992 at an estimated cost of $92 million, was originally scheduled to be completed in fiscal year 1988 at an estimated cost of $32 million. Modifications to reduce benzene hazards and to design and install fire protection systems were major contributors to the schedule slippage and cost increase. Those modifications, which have been ongoing since mid-1988, are currently scheduled to be completed in April 1992 and are estimated to cost $36.4 million, more than half of the ITP's cost increase.

According to DOE officials, one of the prime reasons for the significant differences in the original and current estimated total project costs is the change in accounting practices. In the past, estimated total project costs covered mainly construction costs, whereas under existing practices, all costs necessary to start up a facility are included.

Other reasons for increases in estimated construction costs, as well as estimated total costs, include evolving regulatory requirements, permitting problems, reclassification of facilities from hazardous waste to hazardous waste/radioactive facilities, safety modifications, lack of good cost estimates, and funding constraints. For example, the New Waste Transfer Facility, which was physically completed in the third quarter of fiscal year 1989, is undergoing modifications that are projected to delay its start-up until March 1994. The modifications include improvements to (1) reduce potential environmental contamination and personnel exposure and (2) bring the facility into compliance with DOE design criteria.

Another facility, the Consolidated Incineration Facility, evolved from a hazardous waste incinerator funded by a $21 million project in fiscal year 1983 and the subsequent need for a second incinerator to dispose of radioactive benzene to be removed from waste during the DWPF process. Evolving environmental regulations necessitated a reevaluation of SRS incineration requirements. Amendments to the Resources, Conservation, and Recovery Act (RCRA) in 1984 prohibited, by 1990, the long-term storage of all untreated hazardous and mixed wastes, such as benzene. These amendments also required facilities to treat waste as it was generated. The Consolidated Incineration Facility will provide this required treatment step. Since its initial cost estimate in 1988, the Consolidated Incineration Facility's cost estimates have increased from about $64 million to a fiscal year 1992 estimate of about $160 million, primarily due to evolving

regulatory requirements, permitting delays, modifications, reclassification of costs, and increases in estimated start-up costs.

Management Improvements Under Way

Resulting from the increased scrutiny of (1) SRS-wide problems and (2) the DWPF and its supporting facilities, DOE management at SRS has begun the process to make various management improvements. These improvements include a complete, comprehensive rebaselining of SRS projects,[3] changes to the system for collecting costs at SRS, notification to the Congress of numerous accounting adjustments, and implementation of the Chief Financial Officer organization at SRS. For example, under the direction of the DOE Site Manager at SRS, WSRC is rebaselining all SRS line-item projects by September 30, 1992, to ensure that the scope of SRS projects is only the scope necessary to meet mission requirements. This effort includes ensuring that cost and schedules are based on firm plans and resource-loaded schedules.

Also, under direction of the new DOE Site Manager at SRS, who assumed his position in August 1991, the corrective actions for the DWPF included placing individuals with commercial nuclear industry experience in key management positions, such as the DWPF manager position, and developing an improvement plan. Management improvements resulting from these steps included improvements in the DWPF organization, start-up testing program, schedule, and change control process. For example, the DWPF organization has been completely restructured to clearly define and fix management authority, responsibility, and accountability for start-up activities. Other key DWPF improvements included the development of a new start-up plan in February 1992 and the first comprehensive, resource-loaded start-up schedule.

According to DOE officials at SRS, before the February 1992 start-up plan was issued, a number of documents existed—start-up manual and test plan and start-up strategy—that essentially were start-up plans. The start-up manual is still in place and the start-up strategy document has been replaced by the February 1992 start-up plan. At the time WSRC transmitted the start-up plan to DOE, it still did not contain the status of compliance with DOE Orders as required under DOE procedures. In transmitting the start-up plan, WSRC stated that a program to address

[3]This rebaslining effort includes several items, such as a reassessment of the requirement for each project; a review of the design to ensure that it meets, but does not exceed, the mission requirements; and a review of project costs and schedules to ensure that they accurately reflect any revisions to the project's technical scope.

compliance with DOE orders was being prepared and would be incorporated in the start-up plan.

In addition, in 1991 DOE and WSRC made intensive efforts to improve project management by conducting business management and project reviews, by making changes in management personnel, and by correcting funding irregularities. These efforts are ongoing and include

- assigning persons with commercial nuclear experience to key management positions, including the ITP manager position;
- notifying the Congress of misclassified project costs disclosed by 1991 project reviews;
- developing organizational structures that clearly establish authority, responsibility, and accountability;
- redefining the DWPF's total estimated cost and total project cost so that costs would be properly classified and reported in congressional budget requests until the project starts up;
- acting to provide the Congress with cost information on the waste management cost projects and the basis for continuing to fund them from operating expenses; and
- increasing DOE project management staffing.

Furthermore, action plans have been developed for implementing the recommendations resulting from the 1991 DOE business management and project reviews. The recommendations are scheduled to be implemented by September 1992.

Conclusions

The lack of adequate DOE and contractor management of the DWPF and its supporting facilities has been a principal factor contributing to the tremendous cost growth of the DWPF program and the schedule delays. Other factors, such as system testing that identified technical problems and equipment and design deficiencies, have also affected the DWPF program's cost and schedule.

DOE has acknowledged its and its operating contractor's past management failures and has begun the process of instituting various changes to improve project management practices. These actions are a positive response to the problems that have affected SRS and the DWPF and its supporting facilities. However, given the size and cost of the DWPF program, it is critical that the program continue to receive both DOE and WSRC top management attention to ensure that radioactive operations are

achieved as quickly as possible under current cost and schedule parameters.

Congress Needs More Complete and Accurate Information About the DWPF Program's Cost Growth and Schedule Slippage

The extent of cost and schedule information reported to the Congress on the DWPF program—the DWPF and its supporting facilities—has varied greatly. The information has ranged from DOE budgets that included a line-item project for construction of the DWPF to DOE's use of operating expenses to fund SRS cost projects, such as the ITP facility. Since 1989 DOE has not presented the Congress with the best information DOE had available about the DWPF program's overall cost increases and schedule changes. However, as a result of DOE's examination of funding practices at SRS, DOE determined that the Congress should be provided more complete and accurate information on the DWPF program. DOE had actions under way as of early May 1992, such as initiating efforts to reestablish the DWPF as a separate construction project in DOE's budget submissions, that would provide the needed information.

Improvements Needed in the Information Provided on the DWPF

As illustrated in chapter 2, most of the DWPF's cost and schedule changes took place after fiscal year 1989, when the Congress last made available capital funding for the DWPF's design and construction. Subsequent requests for funding the DWPF work necessary to achieve radioactive operations after construction, such as testing systems, training, and operational readiness reviews, have been included in operational expense appropriations. Because of the way this information is reported and communicated, the Congress has not been fully presented with a clear picture of the DWPF's cost and schedule changes.

DOE's last budget request to the Congress containing DWPF's estimated total project cost was its fiscal year 1989 request. The 1989 budget request reported total estimated DWPF construction costs in DOE's construction project data sheets[1] as a line item of about $930 million and total estimated project costs as about $1.26 billion. Radioactive operations were scheduled to start in the fourth quarter of fiscal year 1990. As discussed in our November 1989 report, the design of the DWPF, according to the project's chief of design and construction, was about 99 percent complete and construction was about 96 percent complete as of September 1989. DOE has since revised the percentage of completed construction to 90 percent to reflect post-mechanical completions. When construction is complete, approximately 2 years of testing will take place before radioactive operations begin.

[1]Construction project data sheets are prepared and submitted for all projects requiring authorization or appropriation in the budget year. These sheets are used to present description, justification, and cost data.

The DWPF has not been reported as a construction line item project since the fiscal year 1989 budget request. For budgetary purposes, construction of the DWPF was considered as being complete. Construction of a completed DWPF that could be used for radioactive operations, however, had not been completed. In fact, if the DWPF does not begin radioactive operations until June 1994, it would be nearly 5 years after construction was theoretically completed, according to DOE's fiscal year 1989 budget information, before radioactive operations may begin. During this period an estimated additional $879 million will be needed to complete the construction and start-up of a DWPF that can perform radioactive operations.

The principal funding source that has been used for this additional work, or is planned for this work—which includes costs for start-up, operation and maintenance of equipment and facilities completed under the line item, operator training, maintenance training, and technical engineering training—has been and is envisioned to continue to be DOE's operating funds for the Savannah River Site. Also, modifications required as a result of start-up testing and technological changes have been funded from operating funds. Funding this work from operating funds, as opposed to construction line-item funding, resulted in DOE budget requests not containing DWPF's total cost or construction project data sheets identifying DWPF cost increases and schedule slippages.

Although the DWPF's cost and schedule status was last reported in the fiscal year 1989 budget, DOE has provided periodic status updates to some congressional committees through reports and letters. For example, DOE sends a quarterly report to the congressional Armed Services and Appropriation Committees[2] informing them of the cost and schedule status of major national security programs. In its report for the quarter ending December 31, 1990, DOE informed the Committees that the DWPF's total project cost had increased to $1.873 billion, construction of the project was 99 percent complete, and radioactive operations were scheduled for the first quarter of fiscal year 1993.

In addition, DOE has separately provided some cost information, not included in the quarterly reports, through letters to the Committees to explain why some of the construction costs had increased. For example,

[2]Section 3143 of the National Defense Authorization Act for Fiscal Years 1990 and 1991, Public Law 101-189 (Nov. 29, 1989), 103 Stat. 1681, generally requires the Secretary of Energy to submit to the Committees on Armed Services and Committees on Appropriations at the end of each calendar year quarter a report on each national security program estimated to cost more than $500 million or designated by the Secretary of Energy as a major DOE national security program.

DOE has used letters to explain that it had misclassified about $120 million in costs that had contributed to a $291 million increase in construction costs. In September 1991 DOE sent a letter to the Committees explaining that it had misclassified about $102 million in costs as operational costs, when in fact they were construction costs that required congressional authorization, and DOE in a subsequent March 1992 letter reported that it had misclassified as operational costs an additional sum of about $18 million in construction costs.

Although DOE informed congressional committees of the misclassified costs in September 1991, the DWPF cost was not updated in the September 30, 1991, quarterly report to the Committees. This report, which was not submitted to the Committees until January 13, 1992, excluded the DWPF completely. The December 31, 1991, quarterly report, which was submitted to the Committees on April 6, 1992, contained the misclassified costs that had been previously provided to the Congress in a September 1991 letter. DOE also used this report to indicate that the DWPF was experiencing delays, that WSRC had presented DOE a revised schedule that would slip the DWPF start-up date to June 1994, and that DOE was still reviewing the proposed schedule. The report did not provide any information on the potential cost impact of slipping the DWPF's start-up to June 1994.

According to the DWPF project manager in DOE headquarters, these changes will not be reported to the Congress until after the Energy Systems Acquisition Advisory Board reviews them. In mid-May 1992 a DOE waste management official at SRS informed us that DOE headquarters-directed reviews of the changes had been completed and DOE was attempting to schedule the Advisory Board's review of the changes for late June 1992. According to DOE officials at SRS, it was possible that DOE may notify the Committees of the updated cost and schedule information before the Advisory Board completes the June 1992 review process.

The issue of using operating funds for construction purposes has been a long-standing DOE problem that we documented about 10 years ago. In 1982 we reported that DOE funded projects from its operations budget to keep estimated project costs within the appropriation and that DOE had notified Congress by letter that some of the costs had been reclassified but that the notifications were for only a small percentage of the total reclassified costs.[3] We concluded that "DOE headquarters liberal policy of transferring costs from capital to operating funds has reduced

[3]Further Improvements Needed in the Department of Energy for Estimating and Reporting Project Costs (GAO/MASAD-82-37, May 26, 1982).

congressional oversight over projects." In addition, we stated that "Full disclosure to the Congress is needed to ensure that projects continue to meet the requirement for which they were funded." The report recommended that the Secretary of Energy take a number of actions, including instituting tighter controls over project funds by requiring DOE headquarters review and approval of all cost reclassifications within individual projects.

Even though some updated cost and schedule information has been reported to the congressional Committees, inconsistencies exist in reported information because costs have not been promptly updated in either SRS quarterly status reports to DOE headquarters or quarterly reports to the Committees. Except for the last report, all of SRS' 1991 quarterly reports to DOE headquarters continued to report DWPF estimated construction costs at about $930 million and estimated total project costs as $1.26 billion, while DOE headquarters report to the Committees for the quarter ending September 30, 1991, excluded the DWPF, even though DOE had informed the Committees in a September 1991 letter of an additional $102 million in construction costs.

Better Understanding Needed on the Full Scope of DWPF Supporting Facilities

The funding of DWPF supporting facilities as cost projects and separate line items did not provide the Congress the necessary kind of information to fully understand the (1) magnitude of the construction cost of facilities required to ultimately vitrify the high-level radioactive waste stored at SRS and (2) continuing cost increases and schedule slippages. Cost projects and line-item projects that are needed to support the DWPF have an estimated cost of about $1.8 billion. Adding the estimated cost of support facilities to the DWPF's estimated cost of $2.1 billion increases to about $3.9 billion the total estimated cost to construct, start up, and upgrade facilities essential to the vitrification of high-level radioactive waste.

The cost projects were the least visible because they were funded from operating funds and, under existing policies, are supposed to be capitalized at project closure. DOE orders provide that projects involving construction of demonstration facilities and other similar facilities where the life of the project is 2 years or less are appropriately funded from operating sources. In recent years SRS has expanded the concept to situations involving an urgent need to do work that ordinarily should be funded as a line item or a general plant project, but where the funding was not immediately available. Such situations, according to the June 27, 1991, SRS Project Review Team Report, were considered acceptable if there had

been appropriate coordination between DOE headquarters and cognizant congressional committees.

In 1991 the DOE team reviewed five cost projects funded at the tank farms for removing and pretreating waste to determine if (1) the projects met the criteria for a capital project or should be part of an existing project, (2) records showed DOE headquarters and/or the Congress were aware that projects meeting capital criteria were funded from operating accounts, and (3) the projects should have been included as part of the DWPF line item. The review drew several conclusions:

- It was not at all clear that the waste removal projects met the criteria for funding from operating accounts, but there is some basis for using operating funding for the waste removal facilities because specific tank facilities and equipment are normally scheduled to operate for less than 2 years. However, scheduled operation of the specific equipment and facilities often exceeds 2 years, and entire projects span up to a decade.
- The ITP and sludge pretreatment facilities were clearly long-life facilities that would normally be funded from capital accounts.
- The waste tank farm projects should not have been included in the DWPF line item because the DWPF project data sheets and project plans do not include work inside the tank farm.

However, even though the projects had been funded from operating expenses, the report concluded that the cost projects were adequately, albeit briefly, communicated in the budget process, culminating in the congressional budget requests. The congressional budget submittals, while not specifically using the term "cost project," did indicate that operating funds were being used to construct facilities for waste removal and waste processing to support the DWPF.

In addition to the waste removal and treatment projects in the tank farm, the construction of saltstone vaults was funded from operating expenses, and DOE plans to continue funding the vaults from operating funds. Three vaults have been constructed at a cost of about $15.9 million. The vaults are being funded from operating expenses because the individual vaults are expected to be filled within 2 years. They are not considered as an asset with any remaining usefulness after being filled; that is, they will not have an extended useful service life or alternative future use. This criterion will allow for the construction of 12 double-wide vaults that DOE projects it will need in the future. DOE estimates that the cost of each double-wide vault will be about $18 million (with an estimated total cost of

$233.5 million for the 12 vaults) and the funding will be provided from DOE operating expenses for SRS.

The issue of how to fund waste disposal vaults that could include the saltstone vaults has not been finalized. In early 1992 a position was put forth within DOE that such vaults should be funded as capital projects on the basis that disposal vaults are nondepreciable assets that guarantee the protection of workers, the public, and the environment from low-level radioactive waste. As a result, in the spring of 1992 DOE reported that a request was being prepared to get the Federal Accounting Standards Advisory Board's guidance on the issue of capitalizing versus expensing waste storage facilities.

Although DOE reviews considered prior reporting of projects from operating expenses acceptable, construction project data sheets for these projects were not submitted with annual budget requests as called for by DOE orders. The Director of DOE's Planning and Budget Division at SRS attributed the failure to submit the construction project data sheets in the past to laxity on DOE's part. If the construction project data sheets had been submitted, they should have disclosed those projects that should not have been funded from operating expenses. According to the Director, very few construction projects should have been funded from operating expenses.

DOE Has Recognized the Need for More Complete and Accurate Information

As discussed earlier, the DWPF had not been funded in DOE's budget as a construction line-item project since 1989. However, several events since then have resulted in DOE deciding that it should provide the Congress with more complete and accurate information on the DWPF program. For example, as illustrated in chapter 3, DOE's ongoing efforts include

- redefining the DWPF's total estimated cost and total project cost so that costs would be properly classified and reported in congressional budget requests until the project starts up;
- acting to provide the Congress with cost information on the waste management cost projects and the basis for continuing to fund them from operating expenses;
- acting to submit construction project data sheets with the fiscal year 1993 congressional budget request for each of the waste management cost projects; and

- acting to submit construction project data sheets with annual budget requests for each construction project funded from operating expenses that exceeds $5 million.

The DWPF was not funded as a construction line-item project in fiscal years 1990 and 1991; as a result, construction project data sheets showing project cost and schedule information were not submitted with budget requests for those years. However, according to DOE financial officials, DOE plans to reestablish the DWPF as a construction line item in fiscal years 1992, 1993, and 1994 (with associated construction project data sheets provided with the budget submissions) because additional capital expenditures are needed for activities related to the DWPF's planned June 1994 start-up.

For example, according to the DOE financial officials, DOE's request for line-item funding for fiscal year 1992 was submitted to the Office of Management and Budget (OMB) as part of a broader request that included reprogramming about $58 million remaining from a $70 million operating expense project funded in 1991 for DWPF post-mechanical completion modifications to the DWPF line item. The reprogramming request was sent to OMB on February 20, 1992, but shortly thereafter, the portion of the request applicable to DWPF was separated from the broader request because OMB wanted more details on the DWPF. The additional details were subsequently provided to OMB on May 5, 1992. Line-item funding for fiscal year 1993 will be provided through an amendment to the fiscal year 1993 budget request. The fiscal year 1994 budget request, which was still being developed as of May 6, 1992, will also include line-item funding for the DWPF. However, according to DOE budget officials, line-item funding and construction project data sheets are required only during the DWPF's start-up phase because funding is needed for construction activities. Otherwise, DOE would have continued requesting funding for DWPF's start-up from operating expenses without construction project data sheets.

Conclusions

Because of the various ways information has been reported on the DWPF and its supporting facilities, the Congress has not been fully informed, through the budget process, about cost increases and schedule changes involving both the DWPF and its supporting facilities. Given the extent of past problems involving the DWPF program and the need to keep the Congress fully informed of the program's status, DOE's future budgets should be used to show the most up-to-date cost and schedule information until the DWPF achieves actual radioactive operations.

DOE has decided that it needs to provide the Congress with more complete and accurate information on the DWPF program. We believe that DOE's efforts to address the funding irregularities and the reestablishment of the DWPF as a line-item project are the types of actions that must be taken so that the Congress will have the needed cost and schedule information to fully understand the current status of the DWPF program.

Unresolved Technical Issues and Other Uncertainties Could Further Affect the DWPF's Scheduled Start-Up and Operation

In addition to increases in costs and schedule slippages, various unresolved issues and other uncertainties have the potential to further affect the scheduled start-up and operation of the DWPF. These problems include technical issues, start-up test continuity and management, and the added rigor of safety, environmental, and other requirements. Many of the issues identified have not been resolved. For example, even though DOE plans to replace in the mid-1990s the existing DWPF pretreatment technology with an alternative method, problems encountered with the existing technology—coupled with potential advances in the new method—warrant a further review by DOE to determine whether the planned replacement efforts should be accelerated.

Technical Issues Still Require Resolution

The technical issues still requiring resolution involve pretreatment technologies, as well as emerging, identified, and even closed technical problems. DOE has also established an outside, independent team to review open technology issues and assist it in determining if there are additional major process-related technology concerns that need to be addressed.

Need to Assess and Evaluate Alternative Pretreatment Technologies

According to DOE officials at SRS, the decisions on pretreatment technologies were based on supporting DWPF schedules and best available information about the processes. This decision-making process has affected both costs and schedule. The existing pretreatment technology—the in-tank precipitation (ITP) process/precipitate hydrolysis process (PHP)—is still experiencing problems, while there are new potential advancements involving an alternative technology—the ion-exchange process (IXP). Under the existing technology the ITP is used to separate the high-level waste from other material in the storage tanks and the PHP removes explosive organics, such as benzene, before the waste goes into the DWPF's melter, where the vitrification process takes place.

In the early 1980s SRS management was searching for the best processes to use in vitrifying stored high-level radioactive sludge and salts. Two processes were examined for removing radioactivity from the salt in the tanks to avoid vitrifying the large quantity of salt. Originally, there was one existing process, an IXP; later in 1981 the Savannah River Laboratory discovered that a chemical could efficiently remove cesium from high-level waste.

After this discovery SRS pursued the development of the ITP process and also continued to develop the original IXP process as a backup to the ITP

process. Then, in 1983 SRS decided to go with the ITP process instead of the IXP and discontinued the development of IXP as a backup.

This decision was based on the lack of a significant cost incentive, the magnitude of IXP developmental work remaining, and the more pressing developmental needs in hazardous waste technology areas. A comparison of estimated project and operating costs, excluding remaining developmental costs, gave IXP a $19 million cost advantage. However, the IXP's advantage was effectively removed because the developmental work for the ITP was estimated to be much less than that required for the IXP. The developmental work for the ITP was estimated at $1 million to $2 million. On the other hand, the developmental work for the IXP consisted of a large number of unknowns, estimated to cost from $20 million to $50 million and take 3 to 5 years to resolve.

Committed to the ITP process, in 1984 SRS selected a precipitate hydrolysis process (PHP) to remove the benzene and other combustible gases from the ITP waste. The PHP—originally estimated to cost $32 million—was constructed in the DWPF at an estimated cost of $68 million, according to a 1990 WSRC study. Later, in 1988 tests of the PHP encountered technical problems. Also, in 1988 environmental and safety hazards involving the ITP resulted in DOE authorizing $21 million for modifications to reduce those hazards. Since 1988 technical, environmental, and safety issues emanating from the ITP process have continued to be a problem for SRS.

In the meantime, a DuPont researcher at the Savannah River Laboratory discovered a ten-fold more efficient resin for removing radioactive cesium from waste using IXP, and DuPont gave some consideration to the installation of an IXP using the new resin. The breakthrough resulted in a study describing the advantages of IXP over ITP/PHP and potential modifications for converting to IXP by installing an IXP system in ITP filter cells. In May 1988 a DuPont consulting engineer estimated it would cost about $23 million to install the IXP in the ITP filter cells but concluded it was not feasible because of required piping modifications. He estimated it would cost about $52 million to install the IXP in a new facility.

In January 1989 DOE informed the Energy Systems Acquisition Advisory Board that problems encountered in testing the PHP could have major impacts on cost and schedule and then initiated a series of actions to further develop the IXP. DOE had the cesium-removal breakthrough independently verified and in June 1989 issued a request for proposal to design and construct an IXP test unit. Then, in September 1989 DOE initiated

an IXP development program costing $1.86 million that included the procurement of an IXP unit and additional testing work examining the cesium-removal technology and how the technology would interact with other aspects of the DWPF. In addition, DOE initiated in November 1989 a study examining the feasibility of replacing the ITP/PHP with IXP. The study's interim results were that the IXP would

- cost about $20 million if placed in the ITP building and about $40 million if placed in a new building (costs were not estimated for associated support equipment that would increase total costs);
- reduce annual operating costs from about $21 million for the ITP/PHP to about $8 million for the IXP;
- be advantageous from a safety and environmental viewpoint since it eliminates the generation of benzene and minor amounts of other organics; and
- take 3 to 5 years to complete necessary laboratory test work, engineering, procurement, and construction.

On the basis of the feasibility study's interim results, the DOE Director of the High Level Waste Division requested in June 1990 that the IXP be added to the fiscal year 1993 budget request as a backup/replacement for ITP/PHP. DOE added the replacement of ITP/PHP with IXP as a 1995-97 $70 millon line item in both the fiscal year 1993 budget and in the Savannah River Site Five-Year Plan (FY 1993 Budget Year) dated June 1991. After the June 1990 request, with apparent resolution of the PHP problems and confronted with funding constraints and limited research resources, DOE gave other research work priority over IXP developmental work, excluding the award of a $372,145 contract in October 1990 for the manufacture of an IXP unit for testing purposes.

According to DOE officials, IXP was not aggressively pursued in the late 1980s because the time needed to develop it would not enable the DWPF start-up schedule to be met. However, even though the DWPF is currently confronted with major cost increases, schedule slippages, and ITP/PHP problems, the development of IXP has continued as a low priority. At the time DOE slowed the ongoing development of IXP in 1990 by giving other research work priority over the IXP work, the DWPF was scheduled to start up in November 1992. Since that time additional ITP/PHP problems have surfaced; DOE has planned an abatement control program estimated to cost $36 million to reduce benzene releases; and the DWPF start-up has slipped to June 1994 and possibly to mid-1995.

Because of concerns that the ITP/PHP problems may not be satisfactorily resolved, SRS has looked at vitrifying sludge only as it had originally planned to do before adding the ITP/PHP processes for vitrifying salt waste along with the sludge. According to the WSRC Manager of Interim Waste, the DWPF could operate about 2 years before the lack of space for storing waste water generated by the sludge-only process would shut down the DWPF operation.

Notwithstanding the problems identified with the existing ITP/PHP processes, SRS management has not evaluated the cost-benefits of (1) continuing work on the ITP/PHP, (2) stopping work on the ITP/PHP and replacing it with IXP, or (3) accelerating the development of IXP. According to DOE officials, such cost-benefit evaluations have not been performed because of ITP/PHP schedule advantages and DOE's belief that they will work. Both SRS and DOE headquarters are committed to ITP/PHP. The officials noted that this commitment still exists because IXP, even though it appears to offer a number of potential advantages, would take a minimum of 6 to 8 years to come on-line, in their opinion. These officials also said that past experience indicates that costs could increase two to three times more than original estimates.

Various DOE reviews and assessments, however, appear to support the need for a more thorough evaluation of IXP versus ITP/PHP. For example:

- Cost reductions could make it more economical to switch now. The IXP could reduce annual operating costs by about $8 million to about $11 million, eliminate future benzene abatement costs of about $36 million, and eliminate remaining ITP/PHP start-up testing and modification costs. Also, with IXP eliminating the production of benzene, it could be possible to reduce construction costs for some DWPF supporting facilities.
- IXP appears to be a much safer process because it does not result in the production of benzene. Elimination of benzene would reduce the radiological risk of accidents in the tank farm by 50 percent or more and also reduce the potential for accidents in waste transfer facilities and in the DWPF.
- ITP/PHP technical problems could adversely affect DWPF start-up, operation, attainment rates, component life expectancy, and glass quality. Solutions, found using downsized models and simulated waste, are available for some of the problems; other problems have yet to be solved. However, even the solutions found may not work in full-sized units with real waste. On the other hand, studies have not identified any problems with IXP that

are considered unsolvable, but IXP has not undergone a rigorous evaluation to identify any such problems.

- ITP produces benzene, and IXP does not. Benzene abatement projects have been planned for ITP and the DWPF to address environmental and occupational health concerns.
- From a vitrification standpoint, slipping DWPF's start-up date to either June 1994 or July 1995 and then vitrifying sludge for 2 years could substantially offset the ITP/PHP start-up advantage over IXP's planned start-up in 1997. DOE officials at SRS believe, however, that it would take 6 to 8 years from 1992—if everything went perfectly—to have a viable IXP. DOE officials also stated that the ITP is scheduled to start pretreating high-level waste salt at the end of 1992 that will free up needed tank space and permit the immobilization of the decontaminated salt at the saltstone facility.

Emerging Technical Problem Could Affect Cost, Schedule, and Operation

An emerging technical problem that could have a significant affect on DWPF cost, schedule, and operation was identified in August 1991. One chemical (sodium nitrite) added to prevent a corrosion problem in the tanks has to be counteracted by another chemical (hydroxylamine nitrate) to achieve attainment objectives at a DWPF process point. This counteracting chemical, however, causes the formation of another chemical, which is explosive (ammonium nitrate), later in the DWPF process.

This problem also demonstrates the level of uncertainty related to proposed solutions to DWPF technical issues. For example, WSRC projected its June 1994 radioactive start date on two technical solutions that it was evaluating to deal with the explosion potential of the ammonium nitrate. The ultimate objective of both solutions was to allow radioactive waste containing the nitrates to age and decompose—thus eliminating the explosion problem—before continuing the process.

One proposed solution would require using two existing tanks to accomplish this aging and decomposition process. However, this solution would allow the DWPF to operate at only 20 percent of its design capacity. The second solution requires building additional tanks to accomplish the aging and decomposition process. This solution would push the radioactive start date to July 1995.

However, these two options were replaced by a third option in March 1992. According to DOE officials, the first two options were replaced because they did not produce the expected attainment levels and would require tanks two and one-half to three times larger than those planned.

This, according to the officials, made the options prohibitive from a cost and operational standpoint. Under the third option, the waste would be washed before entering the DWPF. This option—referred to as late or final washing—reportedly has a 70-percent degree of technical certainty, according to a WSRC task force that examined potential options for resolving this issue. As a result, a confirmatory study was initiated in March 1992, and preliminary results were reported to DOE on May 15, 1992, that late washing was a viable option. WSRC is still continuing its technical review of this option. DOE officials stated that the proposed solution will cost \$20 million to \$30 million but should not affect the planned June 1994 proposed radioactive start date. However, another SRS document indicates that there are concerns that required modifications to the pump pits may not be completed by June 1994 and that stainless steel tanks required to hold the wash water from the process would not be constructed by June 1995. Also, according to the facility manager for the New Waste Transfer Facility, the final wash option may result in the presence of benzene at the facility that has to be mitigated to avoid a potential fire and explosion hazard.

This is not the first time that late washing has been considered as an option for the feed going to the DWPF. In 1986 it was considered as a means to treat ITP-processed waste to prevent corrosion in tanks where it was being held before going to the DWPF. However, late washing was not chosen as the means of treatment partly because of the high cost (\$25 million) of building the final washing facility. At that time it was recognized that the late-wash method provides greater flexibility in processing the waste because it handles wider variations in waste composition and requires changes in only one processing area. In addition, the method does not require making additions or ensuring that solutions are within feed standards.

The late-wash method was not chosen in 1986; instead, the addition of the chemical sodium nitrite was recommended to control corrosion. This recommendation was made even though the nitrite additions affected three distinct processing areas, unlike late washing, which affected only one processing area—the operation of the tank farm. The processing areas affected by the addition of nitrites were (1) the operation of the tank farm, (2) the use of the PHP with its resulting reliance on hydroxylamine nitrate, and (3) the DWPF melter due to changes in feed because of sodium and the addition of hydroxylamine nitrate.

Open Technical Issues Could Decrease Attainment

As of December 1991, 29 additional technical issues involving the DWPF were identified as open by DOE. These issues included a wide variety of technical problems, such as the cleaning technology for vessels and liquid sampling precision and accuracy. One example from the 29 open issues—the generation of gaseous hydrogen attributed to certain metals in the waste referred to as noble metals—provides a further illustration of the difficulty DOE and WSRC face in their attempts to resolve these open issues.

The production of gaseous hydrogen within the DWPF process creates a major potential fire and explosive hazard. Although identified as a technical problem that could affect critical path and major milestones for the DWPF, it was not defined in the schedule of work to be done before radioactive operations until the December 1991 revised schedule was established. Instead, a modification costing $2.75 million was requested in September 1991 to monitor hydrogen concentrations and mitigate the formation of flammable concentrations. This mitigation, according to a WSRC written response to us, would be to operate the DWPF below its design basis and thereby minimize the impact of gaseous hydrogen. The written response acknowledged that attainment would be decreased but stated that safe operations would be maintained.

In requesting the $2.75 million modification, DWPF management also acknowledged that additional scope above that currently proposed may be required to support radioactive operations. A January 1992 line-item estimate for hydrogen mitigation showed that about $5.6 million would be needed for radioactive operation modifications. The use of these funds include design, fabrication, and installation of systems.

Some Previously Closed Technical Issues Could Be Reopened

Forty-four technical issues involving the DWPF were shown as closed because of proposed mechanical design, operating strategy, or chemical changes. One example from these closed issues—the type of melter to be used at the DWPF—provides a further illustration of the potential that even previously closed issues could possibly still affect the DWPF's schedule and costs. Within the melter the glass-forming material is heated and combined with the radioactive waste to form a molten mass that is then poured into the stainless steel canisters.

An additional $2 million was provided in December 1991 to procure, install, and evaluate a different type of melter in the test facility. According to DOE officials, this melter is being pursued not because the existing

melter will not work but because the new melter potentially has a higher throughput and might handle noble metals, which settle at the bottom of the melter after extended periods of operation, better than the existing melter. Waste to be processed after 2 years of DWPF operations is expected to contain noble metals. Depending on the outcome of the melter evaluation, some of the 15 melter or melter-related issues identified as closed in December 1991 may potentially be reopened. For instance, melter process issues, such as glass sample size and handling and design rate demonstrations, could require reexamination. Also, according to a December 1991 WSRC status report on DWPF technical issues, melter behavior can be different from pilot melter testing because of changes in control systems, scale-up effects, and more continuous operations.

Independent Review Team Could Identify Further Technology-Related Problems

Another potential impact on the DWPF's cost and schedule could be the results identified by an outside, independent review team that was established at the request of DOE and WSRC. This team was created in January 1992 and its assessment of technology issues is expected in mid-May 1992. The team will review open technology issues and assist in determining if there are additional major process-related technology concerns that need to be addressed. The 10-member team will also assess the approach used by WSRC to resolve technical issues and determine if it leads to satisfactory and timely resolutions. The team consists of reviewers with expertise in process chemistry and systems, physical processes, analytical chemistry, and ceramic nuclear technology.

Start-Up Testing Issues Could Affect Planned Operations

Initial start-up testing at the DWPF identified numerous issues that have extended the schedule and pushed forward the radioactive start date. However, funding shortfalls could further affect the DWPF's planned radioactive operations. In addition, the ITP is experiencing start-up problems.

Overall Start-Up Testing Problems

Start-up testing has been a constant problem for the DWPF. As discussed in chapter 3, when the DWPF entered the start-up phase in 1989, an adequate start-up strategy had not been defined and a good cost estimate and realistic schedule for radioactive operations were not developed until the first half of fiscal year 1992.

Integrated water runs, the initial start-up testing activity to demonstrate that steam and cooling water systems that control the boiling and

condensing capabilities at the DWPF meet process requirements, did not begin until September 1990. At the time integrated water runs ended, the start-up strategy involved four components: (1) integrated water runs scheduled to begin the third quarter of 1990, (2) cold chemical runs scheduled to begin the third quarter of 1991, (3) waste qualification runs scheduled to begin in January 1992, and (4) "hot" radioactive operations scheduled for February 1993.

The integrated water runs, which were scheduled to be completed by March 1991 and were extended through May 1991, identified a large number of design and equipment deficiencies that extended the schedule even further and delayed the radioactive start date. Since the integrated water runs ended in May 1991, the DWPF start-up schedule has been revised twice. The first revision in August 1991 gave a hot operation date of December 1993. The logic and sequencing of activities in this schedule, however, were found to be greatly lacking by a DOE assessment. As a result, another schedule revision occurred in December 1991. Under this revised schedule chemical runs are to begin in November 1992 with hot operation scheduled for June 1994.

Deficiencies identified during integrated water runs are to be completed before the next stage of testing begins in November 1992. The work identified in integrated water runs included reconciling planned versus actual drawings and field inspections of installed systems because of discrepancies in technical drawings. For example, between January and July 1992, 162 hardware inspections of installed systems are required to ensure that differences between actual "as-built" conditions and design drawings do not exist. These inspections must be done in order to support continued start-up test activities. The inspections are time critical and must be done before chemical runs of the start-up testing can begin.

Overall Waste Management Funding Shortfall Could Affect DWPF Start-Up

A general assumption used in developing the current start-up schedule is that funding will be available as needed for operations and major modification projects to the DWPF. However, given the overall funding shortfall in the waste management area, there is some uncertainty that funds will always be available as needed to achieve the schedule. For example, a June 1991 WSRC-projected distribution of the $100 million fiscal year 1993 shortfall for overall SRS activities showed a $33.5 million impact on the DWPF. The two areas of greatest impact are the DWPF laboratory—about $16.7 million—and capital equipment—about $11.5

million. As of January 1992 the project shortfall had increased to $147 million and had even greater potential to affect the DWPF schedule.

Should shortfalls actually occur, meeting revised schedule requirements for the June 1994 DWPF radioactive operations date may prove difficult, at best. For example, reduced or eliminated funding to the DWPF laboratory would preclude technical assistance to the DWPF during chemical runs and initial radioactive start-up. It would also limit waste compliance work and cause a significant portion of DWPF expertise to be lost.

ITP Start-Up Problems

The ITP is experiencing the same type of start-up problems that caused delays to the DWPF. A November 1991 assessment by WSRC found that the ITP's start-up program is in a reactive mode, which causes an emphasis on schedule completion without requisite attention to detail in documenting the completion of start-up activities. The assessment also found that the project was at least 3 months behind because of operations readiness reviews and the need to complete both overdue and due activities that exceed resource capabilities. The assessment team also concluded that it was possible that schedule delays of 9 months or longer could occur.

Another finding of the assessment was that ITP management's singular and strong focus on completing start-up testing has caused operational and training issues to receive less than needed attention. As a result, no formal provision exists for turnover of tested systems from start-up to operations. Other findings were that the ITP design basis is not published and maintained, test efficiency and methodology are deficient, test closeout and documentation are hard to assess, and the risk of retest is high because of incomplete test summaries.

In order to meet these requirements, the schedule for the ITP's start-up has already slipped from December 1991 to December 18, 1992. The new schedule date is based on 10 assumptions that must occur for the date to remain valid. These assumptions include operational readiness reviews being completed within scheduled time periods, test personnel working around the clock during simulant testing, and approved scope additions not being required before radioactive operations.

Safety, Environmental, and Other Requirements Could Cause Further Delays

The need to resolve any issues brought up by oversight groups who make recommendations to DOE on the safety of nuclear facilities could cause further delays to the DWPF. For example, WSRC's analysis and determination of safety class systems may not be agreed to by DOE's Office of Nuclear Safety or the Defense Nuclear Facilities Safety Board.[1] In addition, supporting facilities, such as the Consolidated Incineration Facility—a facility that will receive DWPF waste by-products and burn them, have not been permitted or constructed. Also, the DWPF's immobilized waste must meet the requirements of the federal repository. These requirements will be developed and finalized as part of the license application. Another potential problem could involve regulatory issues.

Oversight of Safety Requirements May Delay Operations and Increase Costs

Actions taken and planned for DWPF safety issues may not meet the requirements of outside review organizations, such as the Defense Nuclear Facilities Safety Board or even DOE safety groups. For example, a May 1991 study identified nine DWPF safety class items that did not comply with DOE Order 6430.1A—Safety Class Criteria. This order defines safety class items as systems, components, and structures, including portions of process systems, whose failure could adversely affect the environment or safety and health of the public. WSRC estimated it would cost about $104 million to make required upgrades to these systems. Nine safety class items were initially identified.

However, in October 1991 WSRC concluded that the requirements of DOE Order 6430.1A did not apply to the DWPF and provided another assessment that used risk-based assumptions. This assessment resulted in only two systems being identified as safety class items that need upgrades to comply with DOE requirements. These systems are a process cell confinement structure and a new control system to ensure the shutdown of the heating, ventilation, and air conditioning system at the DWPF in the event of an earthquake equivalent to the type most likely to occur at SRS.

As of March 31, 1992, DOE had not approved this new list of safety class items and sent the list back to WSRC with comments. An independent contractor DOE used to analyze the list has raised concerns about (1) the assumptions used to generate the list and (2) why some systems were

[1]The five-member Safety Board was established by section 1441 of the National Defense Authorization Act, Fiscal Year 1989, Public Law 100-456, 102 Stat. 2076, in 1988 and began operations in October 1989. The Board is required, among other things, to (1) investigate any event or practice at DOE defense nuclear facilities which the Board determines has adversely, or may adversely, affect public health and safety and (2) make recommendations to the Secretary of Energy on operations, standards, and research needs necessary to ensure adequate protection of public health and safety.

excluded from the list. For example, one assumption used by WSRC is that a full tank of radioactive materials would not create a hazard to the off-site public if a release should occur. The concern raised by the independent contractor is that the assumption should be based on a partially filled tank that would contain various gases sitting on top of the tank's contents. This scenario could be much more hazardous to the public than a full tank.[2]

Even if DOE approves this list, outside review organizations, such as the Defense Nuclear Facilities Safety Board, may not agree. The planned DWPF schedule could be affected, depending on any potential problem areas the Safety Board review may find.

Another safety area that could affect the scheduled start-up of the DWPF is fire protection. DOE's Fire Hazard Analysis determined that sprinklers should be added to the DWPF. However, installing these sprinklers is not to be completed until May 1994 under the current schedule. The DOE Office of Facility Safety says that the sprinklers must be installed before the start of chemical testing, scheduled to begin in November 1992. Although the issue was being negotiated in March 1992 by the DWPF project office and the Office of Facility Safety, the resolution of this issue could delay the scheduled November chemical run date. According to the DWPF project representative responsible for fire protection, the SRS manager would have to approve chemical testing if the issue is not resolved. However, DOE's Deputy Assistant Manager for Environmental Restoration and Waste Management at SRS stated that the approval would have to be given at DOE headquarters, probably by the Secretary of Energy.

Permitting and Construction of an Incineration Facility Could Affect Operations

The permitting and construction of an incineration facility could affect the operation of the DWPF. The Consolidated Incineration Facility, which will burn benzene and other organics generated as waste by-products during the vitrification process, has not been permitted and constructed. Until this facility is constructed and becomes operational, DOE plans to temporarily store on-site the benzene generated by the DWPF processes. The storage tank will hold approximately 150,000 gallons of liquid benzene—the amount expected to be produced during the DWPF's first 3 years of operation. However, according to DOE officials, getting a permit for an incinerator is a difficult process, and it may be even more difficult to get a permit for an incinerator that burns radioactive materials. Should

[2]Although we have not examined the scenario raised by the consultant, GAO has previously discussed the potential for explosions involving high-level waste stored in underground tanks. This work involved DOE's Hanford Site near Richland, Washington. See Nuclear Energy: Consequences of Explosion of Hanford's Single-Shell Tanks Are Understated (GAO/RCED-91-34, Oct. 10, 1990).

there be a problem in the permitting of the incineration facility, the extent of the DWPF's operation could be limited to the time required to fill the temporary benzene storage tank. In addition, the two facilities needed for disposal of the incineration facility's waste have not been constructed.

Waste Acceptance Preliminary Specifications Are Currently Unknown

Since the ultimate customer of the DWPF's immobilized waste is the federal repository—with unknown requirements—the DWPF's waste acceptance preliminary specifications are subject to possible change. These specifications identify various requirements that must be met before the waste will be accepted at the repository. It addresses the waste form, the canister, the canistered waste form, and quality assurance of waste acceptance process activities. The specifications may be revised periodically as the DWPF process is optimized and as repository requirements are defined. As the repository requirements are developed for the DWPF waste, the DOE Office of Civilian Radioactive Waste is responsible for issuing and approving the specifications.

Regulatory Issues Could Affect Schedule

Regulatory issues that must be addressed could further affect the DWPF's planned start-up. For example, the federal facilities compliance agreement between DOE and EPA currently calls for a DWPF radioactive operation date of December 1993. However, the current DWPF schedule prepared by WSRC projects a June 1994 radioactive operations start-up date. In transmitting the current schedule to DOE, WSRC proposed that the compliance agreement date be extended to July 1995 to correspond with the worst-case start-up schedule for the DWPF. According to DOE's DWPF environmental engineer, no schedule change will be formally submitted to EPA until it is reviewed and approved by DOE. He added that EPA has been told informally that a schedule change would be needed because of unexpected technical issues. However, a formal submission will not be sent to EPA until WSRC finishes its analysis of technical issues and DOE approves the proposed schedule.

Another regulatory issue that could affect the start-up and continued operation of the DWPF is the disposal of filters that will be radioactive and contaminated with mercury and benzene after their use in the ITP. DOE is expecting to treat and dispose of these filters in a vault. However, before this can be done, a variance must be obtained from EPA. This variance was submitted to EPA in January 1992, but according to the DOE's ITP project engineer at SRS, EPA had not formally approved this request as of May 19, 1992. If the request is not approved, the ITP cannot operate.

Conclusions

The DWPF project still faces unresolved technical issues—such as the ammonium nitrate and hydrogen problems—and other uncertainties—such as the need to resolve any issues that may be brought up by oversight groups who make recommendations to DOE on the safety of nuclear facilities—that could affect the DWPF's cost, schedule, and operation. Although DOE is fully aware of the unresolved technical issues and other uncertainties, it believes that the schedule slippage offers it the time to come up with viable solutions to the currently known problems and to deal with the uncertainties as they arise. In addition, because of problems involving the ITP/PHP and what appear to be promising new advances with the IXP, DOE has an opportunity to build on its earlier work examining IXP. Such an examination could provide more definitive answers on whether IXP is a simpler, cheaper, safer, and more reliable process than ITP/PHP. This information would help DOE in reassessing its schedule for replacing ITP/PHP with IXP.

Recommendation to the Secretary of Energy

We recommend that the Secretary of Energy direct that an assessment and comparison of the IXP technology and the ITP/PHP be prepared to determine whether DOE should accelerate its planned efforts to replace the ITP/PHP with the IXP.

Evolution of the DWPF Program and Description of Supporting Facilities

This appendix provides information on (1) the evolution of the DWPF program and (2) a description of the various facilities required to support it.

Evolution of the DWPF Program

Excluding the process for removing the waste from the storage tanks, the DWPF program has evolved greatly over time. Initially, the planned DWPF consisted of a single facility containing both the pretreatment and immobilization functions that would cost an estimated $2.8 billion. The DWPF would use an ion-exchange process (IXP) to pretreat high-level radioactive salts. The subsequent evolution of the program was caused by a number of factors, including funding decisions, design changes,[1] technological changes, and regulatory requirements. Key events resulting in the evolution of the DWPF follow:

- The sludge-washing function was transferred in 1980 from the DWPF to the tank farm, which added in the extended sludge-processing project. This change decreased the size of the DWPF, simplified the sludge-washing process, and provided greater process flexibility by separating sludge and supernate processing.
- The decision was made to construct the DWPF in two stages. In 1981 DOE decided to construct the DWPF in two stages in order to reduce the initial and total capital investment. The reduction in the initial capital investment resulted from staging; the reduction in the total capital investment resulted from improvements in an ongoing research and development program. The first stage would provide an immobilization facility housed in a concrete canyon building to incorporate the insoluble sludge portion of the waste in glass because the sludge, which makes up about 10 percent of the waste volume and about 60 percent of radioactivity, presents the greatest long-term radiological hazard.

  The second stage would provide another facility housed in a second concrete canyon building to decontaminate waste salt solutions and transfer recovered radionuclides to the first-stage immobilization facility for incorporation in glass. The decontaminated salt solution would be incorporated into a concrete matrix and placed in an engineered landfill. Subsequently, in 1982 DOE submitted a fiscal year 1983 budget request for $970 million total estimated cost[2] to construct the first-stage facility to

[1]Resulting from design changes, the size of the DWPF in terms of volume was reduced from about 27 million cubic feet to about 5 million cubic feet.

[2]Total estimated cost is defined as all design and construction costs, including any corrective actions due to design or construction errors up to the point of radioactive operations.

solidify the sludge portion of the waste that contained most of the radioactivity. The request stated that a facility would be constructed later, if required, to process the soluble salt portion of the waste. Estimated total project cost[3] for the first-stage facility was $1.529 billion.

- A new technology for decontaminating high-level waste was discovered. Savannah River Laboratory scientists discovered late in 1981 that cesium could be efficiently removed from the high-level radioactive salts by precipitating them with sodium tetraphenylborate. The precipitation process—referred to as in-tank precipitation (ITP)—was simpler, cheaper, and more efficient than the IXP to be used in the second-stage facility. Also, the new precipitation process could save a significant amount of capital investment in the second stage because it could possibly be housed either in an existing canyon building or in the existing waste tanks, or in a significantly reduced second-stage building.
- The decision was made to replace the IXP technology with the ITP technology and to not pursue further development of IXP as a backup. DOE replaced the DWPF's original technology for pretreating high-level radioactive salt with the newly discovered precipitating technology.

The change in technology provided ITP processing in the storage tank area. This eliminated the need to construct a second canyon building and permitted the immobilization of sludge and radionuclides recovered from the salt to start at the same time. However, the technology also required a process for interfacing the ITP process with the DWPF melter because the ITP feed could not be added directly to the melter feed stream. The ITP feed contains volatile organic compounds, and these compounds can reduce to metals many of the waste components in the feed stream going to the melter. These metals could then "short out" the melter. To preclude this from occurring, a precipitate hydrolysis process (PHP) was subsequently installed in the DWPF to remove the organics from the ITP feed stream.

The ITP process removes radionuclides in the supernate by adding sodium tetraphenylborate to the supernate to precipitate cesium (and potassium) and sodium titanate to adsorb strontium. Use of sodium tetraphenylborate results in the formation of volatile organics—primarily benzene—in the (1) ITP by the radiolytic decomposition of sodium tetraphenylborate; (2) DWPF by the destruction of the sodium tetraphenylborate precipitating reagent, prior to blending the precipitated radionuclides with the high-level radioactive sludge; and (3) saltstone facility by the heat generated from the

[3]Total project cost is defined as the sum of total estimated cost and all other project costs, such as testing, training, and operational readiness reviews, necessary to achieve radioactive operations.

curing saltstone, although the amount generated is considered insignificant. Benzene was not formed by the original IXP.

- A breakthrough occurred in IXP technology in 1987. When compared with ITP/PHP, IXP appeared to (1) require fewer steps and facilities; (2) have lower operating costs; (3) eliminate the production of benzene anywhere in the system, hence no benzene explosion potential or toxic problem; (4) avoid the uncertainty of process equipment performance from the formation of organic tars; and (5) reduce the amount of hydrogen produced. Although the IXP technology appeared to be an alternative to ITP/PHP, no formal evaluation was performed to determine if the potential advantages of IXP outweighed the capital costs and schedule delay that would result from converting to the IXP technology.
- Additional facilities and modifications were needed to reduce environmental and safety hazards. For example, the generation of benzene required additional facilities to dispose of the benzene and modifications of existing facilities to prevent benzene releases, fires, and explosions. The additional facilities included construction of (1) an incinerator to burn the benzene, (2) a facility to store the incinerator rundown waste, and (3) a facility to store the incinerator ash waste. In addition to its use for the DWPF waste, the incinerator will be used for other wastes generated at SRS. According to DOE officials, the incinerator is required for SRS waste with or without the DWPF.
- Facilities were deleted. The DWPF's incinerator was deleted from the DWPF's line item in 1988, and $14.8 million was transferred to another line-item project that includes construction of the consolidated incinerator facility. A shipping facility was also deleted in 1989 because it was not a near-term need. In addition, the first saltstone vault was deleted in 1986 and reclassified as a cost project funded from operating expenses on the basis of DOE's criteria for funding projects from operating expenses.

Description of Facilities Required to Support the DWPF Program

In general, the ability to vitrify the high-level radioactive waste requires a number of facilities to retrieve, pretreat, immobilize and process, reduce, transfer, and store the various waste streams. The following sections briefly describe these facilities.

Waste Removal From Tanks. The sludge, saltcake and supernate are stored in 750,000- to 1,300,000-gallon tanks that range from 75 to 85 feet in diameter and from 24.5 to 33 feet in height. Facilities required to remove the salt and sludge from the waste storage tanks include pump support structures, slurry pumps, slurry pump motors, and associated equipment

for salt dissolution and sludge suspension; transfer pumps for transfer of the sludge after suspension; transfer jets for transfer of the dissolved salt solution; and an equipment storage facility.

Extended Sludge Processing. This processing, which uses three existing waste tanks, required the installation of pumps and piping to wash the sludge. The process washes the sludge taken from the waste tanks to remove soluble salts and aluminum from the sludge before it is fed to the DWPF. It includes five basic steps: (1) hydraulic slurrying of the stored sludge from waste tanks, (2) aluminum dissolution with sodium hydroxide and steam heat, (3) washing with inhibited water to remove dissolved solids, (4) gravity settling, and (5) decanting the salt solutions back to the tank farm for processing.

In-tank Precipitation (ITP). The purpose of the ITP is to remove radioactivity from the dissolved salt component of the high-level wastes by precipitation and absorption and then separate the resulting high-activity solids from the decontaminated salt solution via filtration. The high-activity solids will be stored and transferred to the DWPF. The low-activity decontaminated salt solution will be stored and transferred to the saltstone facility. More specifically, the ITP removes more than 99.9 percent of the radioactivity from the salt by adding sodium tetraphenylborate and sodium titanate to the ITP feed tank to precipitate cesium (and potassium) and adsorb strontium, respectively, from the dissolved waste salt solution. After filtration, the precipitate is washed with water, concentrated, and transferred by batch to the feed tank for the DWPF. The wash water is collected and recycled into the next cycle of ITP. The decontaminated salt solution (filtrate) will be stored separately and then fed to the saltstone facility. When the DWPF becomes operational, the precipitate will be transferred to the DWPF for vitrification. Facilities required for the ITP, which uses three existing waste tanks, included the construction of remotely operated and shielded cells, storage/handling facilities, and control room, as well as the installation of pumps and piping.

Saltstone Facility/Vaults. The saltstone facility, which is part of the DWPF line item, is a less expensive means of disposing of decontaminated waste by reducing the volume of glass being produced at the DWPF. The salt decontaminated by the ITP process, which is a low-level radioactive salt solution, is pumped from the ITP to the saltstone facility. The salt solution is then mixed with predetermined quantities of slag, fly ash, and a lime source. The resulting grout mixture, referred to as saltstone, is then

pumped to a concrete disposal vault where it solidifies and forms a nonhazardous solid matrix. The disposal vaults are designed to minimize the leaching of hazardous chemicals and radionuclides that are contained in the saltstone matrix, provide radiation protection during operation, and serve as a barrier to potential intruders in future years.

DWPF. The DWPF receives and immobilizes the high-level waste in glass. The DWPF's main process operations are precipitate hydrolysis, feed preparation, melter, melter off-gas, canister handling, process ventilation, process services, mercury purification, and analytical sampling.

Waste Transport. The precipitate, sludge, and recycle wastes are transported between the tank farm and the DWPF by a complex of two pump pit facilities and interarea transfer piping. Each of the two pump pit facilities—Low Point and Auxillary—are housed in 40-foot-tall steel frame buildings. Each facility contains three radiologically shielded pump tanks (12 feet in diameter and 8.5 feet high) in separate stainless steel-lined pits for separate movement of the three streams—sludge, precipitate, and DWPF recycle waste. The two facilities are required because of the Bingham plastic characteristics (high shear stress) of the precipitate and sludge, and the greater than 6,000-foot distance separating the two facilities. The tank farms, pump pits, and vitrification facilities are connected by two sets of pipes, each consisting of two 3-inch stainless lines inside a 10-inch carbon steel jacket. These lines are all sloped toward the low points and each jacket is provided with leak detection. One 3-inch stainless steel line is used for each of the process services—sludge, precipitate, and DWPF recycle waste—with the fourth being a spare. Each of the six pump tank pits is also provided with tank and liner leak detection.

New Waste Transfer Facility. This facility is required for the transfer of the aqueous recycle from the DWPF to the tank farm and the transfer of waste from one area of the tank farm to the ITP. It consists of a control room, a diversion box, four pump pits, and required transfer piping and equipment.

Canister Storage Facilities. These facilities will be used to temporarily store the canisters of immobilized high-level waste. SRS has constructed one canister storage building designed to hold 5 years of DWPF glass waste production—about 2,286 canisters. However, SRS will need to construct another storage building because the one constructed will be filled before the federal waste repository receiving the canisters is scheduled to open in 2008.

Consolidated Incineration Facility. This facility will detoxify and volume reduce low-level radioactive, hazardous, and mixed wastes through incineration. It will incinerate an estimated 86,500 gallons of liquid waste and about 627,650 cubic feet of solid waste annually. The waste is received from the DWPF and other SRS facilities. About 53 percent of the liquid waste is benzene and other organics generated by the DWPF. Such treatment of hazardous wastes is required by environmental regulations before it can be properly disposed of.

Hazardous Waste/Mixed Waste Disposal Facility. This project, which is required with or without the DWPF, will provide a permanent Resources, Conservation and Recovery Act (RCRA) permitted treatment and disposal facility for specific solid, hazardous, and mixed waste that cannot be disposed of in existing or planned SRS facilities. This project will provide disposal for the incineration facility's ash.

M-Area Waste Disposal (Y-Area). The Y-Area project, which will receive waste from the incineration facility and other SRS facilities, will provide a RCRA-permitted processing and disposal facility for hazardous and low-level mixed waste salt solutions. The Y-Area disposal facility will process waste from the M-Area Fuel Fabrication Facility and the incineration facility. The waste will be combined with concrete, flyash, and slag and pumped into RCRA vaults. The facility will process the current inventory of M-Area mixed waste salt solution and will support the incineration facility by treating and disposing of the scrubber blowdown. Excluding the waste stored at M-Area, about 86 percent of the projected waste generated annually for storage in this facility is from the incinerator scrubber blowdown. However, due to a change in the M-Area production process, DOE is trying to obtain EPA approval to rescope the project for disposal of incineration waste only. If this rescoping is approved, 100 percent of the waste will result from the incinerator scrubber blowdown. Also, a proposed alternate approach for the incineration facility's waste is to treat and stabilize the blowdown and then store it in the hazardous/mixed waste vaults, thereby eliminating the M-Area disposal facility. DOE officials informed us in April 1992 that DOE is recommending that this project be canceled.

Other Facilities. Other waste operations facilities are also essential to the immobilization of the high-level waste. These include new facilities, such as the replacement of the high-level waste evaporator, and existing facilities, including some that must be upgraded for continued operations.

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